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TO: Steve Smith, Supervisor, AZ/NM

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BUENOS AIRES NATIONAL WILDLIFE REFUGE

PRONGHORN STUDY TEAM REPORT

June 1, 1987

Prepared by:

**Steve J. Dobrott, Ron Olding,
Richard Remington, Alisa Shull,
and Stephen Williams**

PREFACE

The purpose of this study was to prepare, to the Regional Director, an objective and biologically sound assessment of whether the Sonoran or Chihuahuan subspecies of pronghorn (Antilocapra americana sonoriensis or A. a. mexicana) should be reintroduced onto the Buenos Aires NWR.

The report includes information on historic ranges and factors affecting the biological viability of each subspecies, as well as an assessment of the availability of transplant stock. A scenario of expected events leading to successful introduction of each subspecies is presented, followed by a discussion of decision factors. The full report is preceded by a summary.

The study team which produced this report includes the following members:

Steve Dobrott, Team Leader, Buenos Aires NWR
Ron Olding, Arizona Game & Fish Department
Richard Remington, Sonoran Pronghorn Recovery Team
Alisa Shull, Regional Endangered Species Office, USFWS
Stephen Williams, Arizona State Land Department

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REPORT SUMMARY

BACKGROUND INFORMATION

HISTORIC RANGE

While pronghorn did occur in the Altar Valley, no conclusive evidence was found to substantiate which subspecies, A. a. sonoriensis or A. a. mexicana, historically occupied the Buenos Aires NWR.

CURRENT STATUS

Sonoran pronghorn listed as endangered and restricted to southwest Arizona and northern Sonora, Mexico. Chihuahuan pronghorn is considered rare in Arizona, New Mexico, and Chihuahua, Mexico.

BIOLOGICAL CONSIDERATIONS

PRONGHORN BIOLOGY

Habitat Characteristics

The Sonoran pronghorn is found primarily in the Sonoran desertscrub vegetative community. The Chihuahuan pronghorn occurs in both semidesert grassland and Chihuahuan desertscrub vegetative communities. The Buenos Aires NWR is characterized as a semidesert grassland vegetative community.

Climate

The climate in existing Sonoran pronghorn range is extremely hot and dry. The climate in Chihuahuan pronghorn range is generally cooler and wetter. The climate of the Buenos Aires NWR is similar to that of Chihuahuan pronghorn range.

Breeding

Breeding in both subspecies is closely associated with climate. Sonoran pronghorn breed in July-September and fawn in March. In Texas, Chihuahuan pronghorn breed in August-October and fawn in May-June. In New Mexico and Chihuahua, Mexico, fawns have been reported as late as July and August.

Home Range

Home ranges of Sonoran pronghorn are generally large and probably a function of limited availability of forage and water. Chihuahuan pronghorn have much smaller home ranges attributed to greater availability of forage and water.

Food Preference

Both species seem to prefer areas with an abundance of forbs and high diversity of shrubs.

Water Requirements

Water is essential for Chihuahuan pronghorn at most times of the year. Sonoran pronghorn water requirements are much lower.

BUENOS AIRES NWR SUITABILITY ANALYSIS

The BANWR was determined by the team to be suitable for either pronghorn subspecies. An estimated 130 sections of the refuge are currently considered potential pronghorn habitat. A population of approximately 150-200 pronghorns could exist on the refuge with a good possibility of expanding beyond the refuge boundaries. The area of the refuge considered best suitable for an initial release is southeast of the headquarters.

REINTRODUCTION SCENARIOS

AVAILABILITY

A Sonoran pronghorn transplant would require captive propagation from animals captured from the current population. Beginning with six to ten captive pronghorn, the herd should expand to forty animals in four to seven years. Until that time the herd would be confined to a breeding enclosure.

Chihuahuan pronghorn would be directly released onto the refuge. Approximately 50-100 pronghorn should be available immediately from Texas. Approximately 30-50 pronghorns may be available from the Gray Ranch in New Mexico. Gray Ranch pronghorn are preferable because of apparent adaptations to a climate similar to that of the refuge.

PREPARATIONS FOR RELEASE

Fencing

For Sonoran pronghorn, a 700-acre predator-free fenced enclosure would be required. For both subspecies, some modification of other refuge fences would be necessary to permit free movement within the refuge, and to contain the pronghorn in some cases where movement is not desired.

Water

Some modification of existing permanent water sources may be necessary for either subspecies.

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CAPTURE

Sonoran pronghorns can be captured with the use of net guns fired from helicopter. Chihuahuan can be captured by drive-trap method. Capture would be conducted by the state wildlife agencies involved.

MANAGEMENT

Both subspecies will require some predator control, but for Sonoran pronghorn it will be more intensive and longer duration because reproductive success is more critical.

SURVEYS

Intensive surveys to monitor transplant success will be required for either subspecies.

HUNTING

Hunting of Sonoran pronghorn would only occur after recovery goal of 300 is reached and the subspecies is delisted. Chihuahuan pronghorn would be huntable.

HABITAT MANIPULATION

Habitat manipulations to improve antelope habitat would have similar diversity goals as for masked bobwhite. Prescribed burning is perceived by the team as being highly beneficial for pronghorn.

CONFLICTS

Possible conflicts involving the Sonoran pronghorn alternative derive from its endangered status and include landowner cooperation problems, hunting conflicts, and possibility of interbreeding possibilities with other subspecies.

Without the endangered species status, the Chihuahuan pronghorn alternative has no major foreseeable conflicts.

DISCUSSION

Because no conclusion is possible on historic range, biological considerations should determine the reintroduction decision. The two major factors are the fact that Buenos Aires NWR habitat and climate are somewhat more similar to that of Chihuahuan pronghorn than that of Sonoran, weighed against the need to establish a second population of the endangered Sonoran pronghorn.

No team consensus was reached on which subspecies to recommend for reintroduction.

BACKGROUND INFORMATION

HISTORIC RANGE

Historic range is an important factor in any reintroduction decision. Unfortunately, with the data available, it is impossible to determine unequivocally whether Sonoran pronghorn (Antilocapra americana sonoriensis) or Chihuahuan pronghorn (A. a. mexicana) historically occurred on lands now included in the Buenos Aires National Wildlife Refuge.

Much of the uncertainty about the Sonoran pronghorn's historic range is due to the small number of specimens and disagreement over the subspecies classification of at least one of those specimens.

The sonoriensis subspecies was named and described by Goldman in 1945, based on a female pronghorn from Sonora, Mexico. Goldman also examined a female specimen from Fort Buchanan (now Crittenden) in Santa Cruz Co., Arizona. Crittenden is just west of Sonoita, Arizona and east of the Altar Valley.

Goldman classified this specimen as A. a. sonoriensis but noted that on geographic grounds, specimens from southeastern Arizona could be expected to show morphological gradation toward A. a. mexicana.

Paradiso and Nowak (1971) say that "the female from Crittenden, Arizona, although probably referable to sonoriensis, appears intermediate between that race and mexicana in some characters." However, Hoffmeister (1986) thinks this specimen is referable to A. a. mexicana. He says that "the skull is larger than the one female (type) of A. a. sonoriensis, yet the specimen from Ft. Buchanan is younger than the type specimen." He also states that the type specimen may be smaller than average for the subspecies.

Hoffmeister described the range of the Sonoran pronghorn as "southwestern Arizona, south of the Bill Williams River and west of the Baboquivari Mountains" (Fig. 1).

Hall (1981) refers the Crittenden specimen to A. a. sonoriensis. He refers to a specimen from the base of the Huachuca Mountains, approximately twenty miles to the east, as A. a. mexicana and draws a line between the two to define their respective ranges (Fig. 2). (Since these areas are only twenty miles apart and are one of southeast Arizona's largest portions of contiguous pronghorn habitat, this line may be an artificial and arbitrary separation.)

In their 1981 Sonoran Pronghorn Special Report No. 10, the Arizona Game and Fish Department included a chapter on the "Historic Distribution of the Sonoran Pronghorn" by Phelps and Webb. The historic distribution that they present (Fig. 3)

resulted from examination of recorded observations of Sonoran pronghorn and an interpretation of subspecies affinities based on ecological criteria. They include the Altar Valley in sonoriensis range.

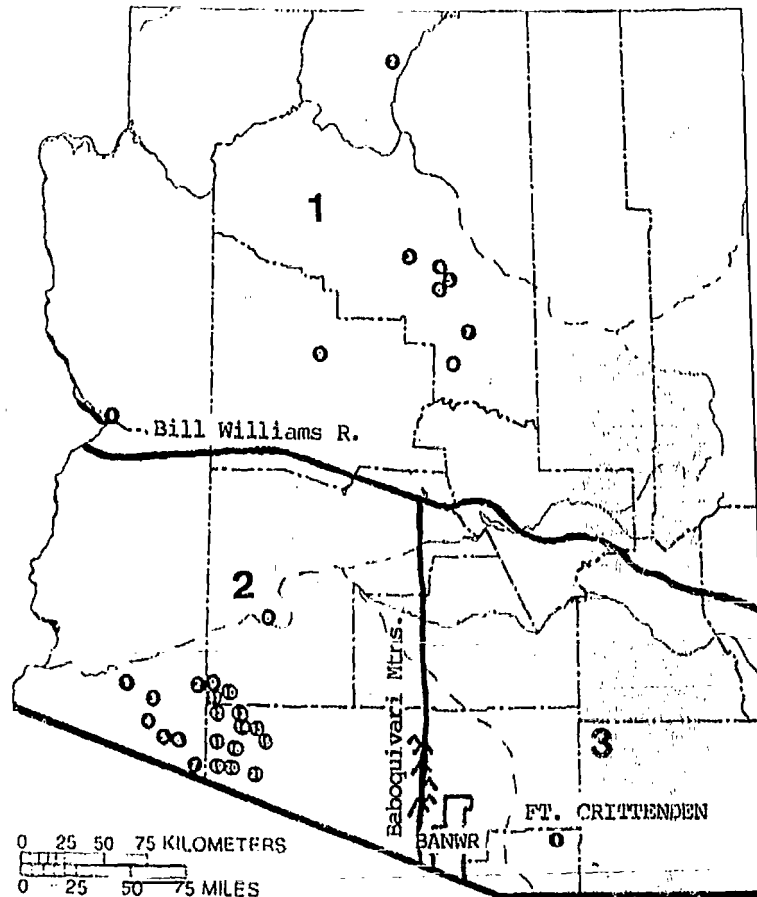


Figure 1. Distribution of pronghorn (*Antilocapra americana*: 1. *A. a. americana*, 2. *A. a. sonoriensis*, 3. *A. a. mexicana*), from Hoffmeister, 1986, Mammals of Arizona, p. 549.

Carr's report (1971) of up to 200 pronghorn in the Altar Valley comes from a report by Arrington (1942) which he quotes:

"Mr. Manual King, owner of the large Anvil Ranch lying northeast of Baboquivari Peak, has lived in Altar Valley since 1885."

"He states that until 1902 grass extended throughout the

valley from mountain slope to mountain slope with only an occasional tree. Antelope herds of up to 200 ranged, principally at the edge of the mountains. The last band he recalls seeing was in 1966. It had approximately 30 members. Only occasional groups were seen after that and none at all since 1933."

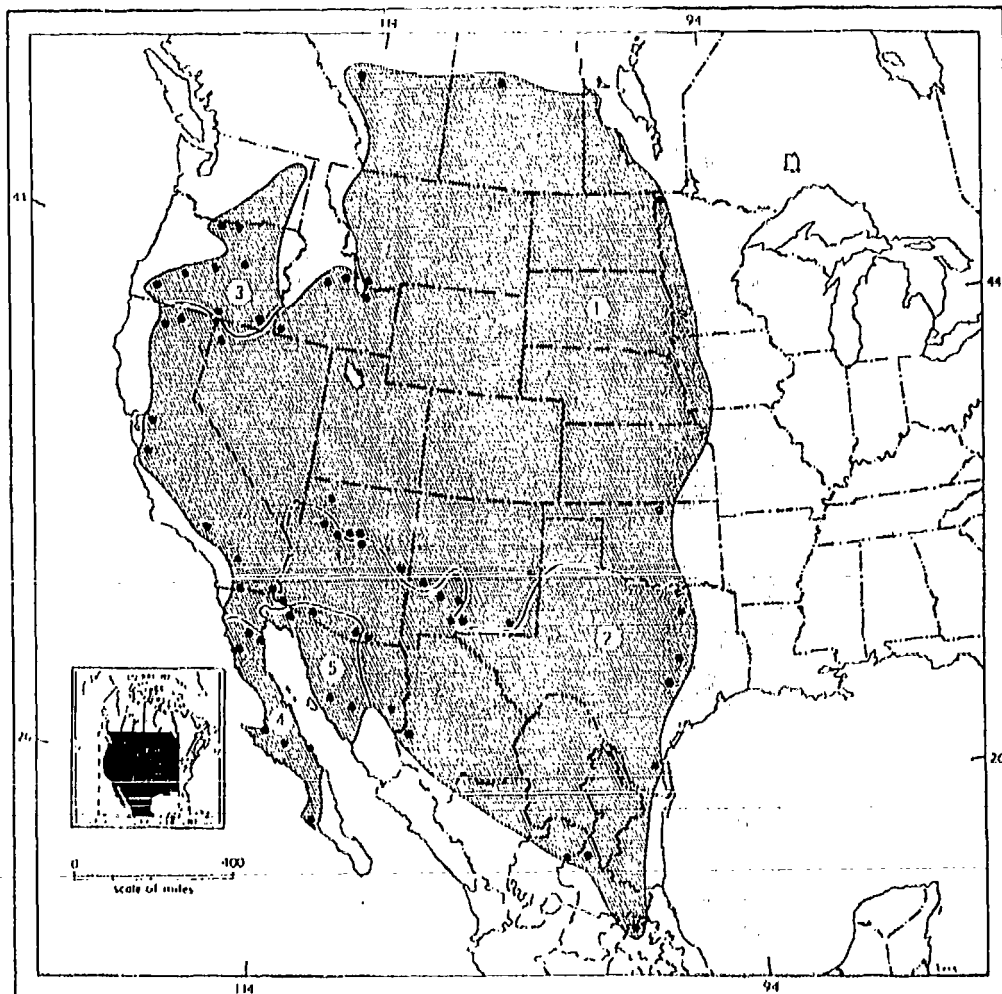


Figure 2. Distribution of pronghorn (*Antilocapra americana*: 1. *A. a. americana*, 2. *A. a. mexicana*, 3. *A. a. oregona*, 4. *A. a. peninsularis*, 5. *A. a. sonoriensis*), from Hall, 1981, The Mammals of North America.

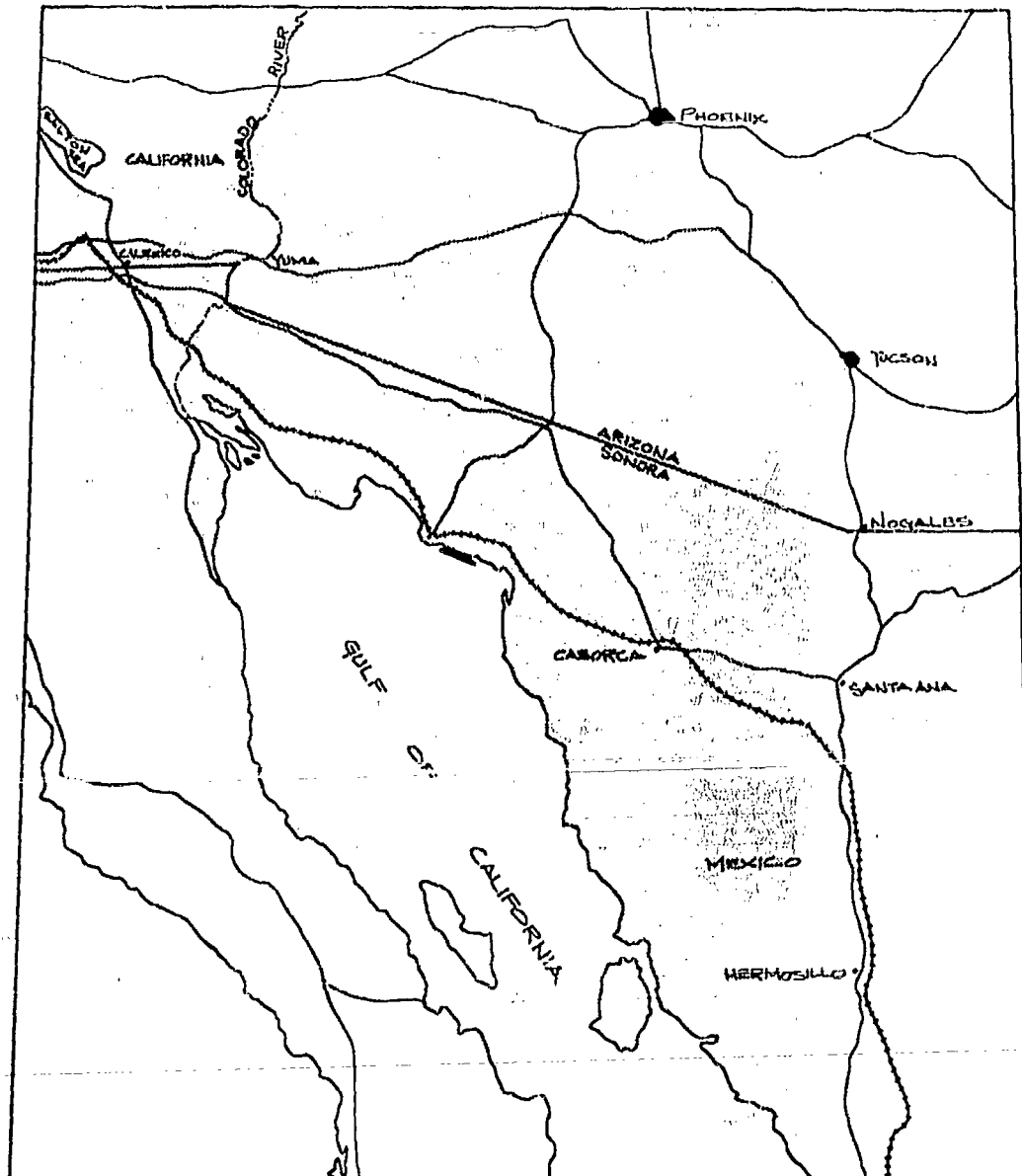


Figure 3. Historic distribution of Sonoran pronghorn, from Phelps and Webb, 1981, The Sonoran Pronghorn, Special Report Number 10, page 21.

Carr further says that "it is not definitely known if the pronghorn of Altar Valley were sonoriensis. It can be presumed they were. The easternmost range of sonoriensis has been placed at old Fort Crittenden, Arizona (Hall and Kelson, 1959) some 40 miles to the east of Altar Valley. The Fort Crittenden pronghorn, however, is most likely a transition between A. a. mexicana and A. a. sonoriensis (Goldman, 1945)."

In summary, the border between the historic range of A. a. sonoriensis and A. a. mexicana appears to be somewhere around the Altar Valley. No data exists to conclusively determine an exact boundary. Most likely, an intergrade between the two subspecies occurred in the Altar Valley, rather than a definite boundary.

CURRENT STATUS

Sonoran Pronghorn

Sonoran pronghorn were a common member of Arizona's fauna prior to the twentieth century, ranging over most of southwest Arizona and northwest Sonora and into southeast California. By the mid-1920s the population had declined to approximately 100 individuals, and the subspecies had been extirpated from much of its former range in Arizona and Mexico and totally extirpated from California.

Within more recent years, Sonoran pronghorn numbers have remained stable at approximately 100 individuals within Arizona. However, they no longer occur in some areas which were part of their historic range, such as the Papago Indian Reservation, where they have not been seen for the past fifteen years.

The Mexico population, estimated to be in excess of 300 individuals in 1980, had fallen below 100 individuals by 1985. At this rate, it is possible that Sonoran pronghorn could be totally extirpated from Mexico within the next ten years. The total world population estimate for Sonoran pronghorn had fallen from 350-400 individuals in 1980 to less than 200 remaining by 1985 (AGFD, 1987).

The current official status for Sonoran pronghorn is as follows:

1. International Status: Code of Federal Regulations, Title 50, Chapter 1 USFWS Subpart C 23.23, Appendix 1, October 1, 1984, p235, listed 7-1-75.
2. Federal Status: USFWS Endangered & Threatened Wildlife & Plants, July 27, 1983, page 8. 50CFR 17.11 & 17.12. Endangered, listed March 11, 1967.
3. State Status: Threatened Native Wildlife in Arizona.

Current recovery plans call for an increase in the population within the U.S. to 300 individuals (average for a five-year period) or numbers determined feasible for the habitat. Within the current distribution areas of Sonoran pronghorn, numbers may never increase substantially above population levels of the 1920s. A possible solution to meet recovery needs and effect a long-term expansion of Sonoran pronghorn populations is to expand their distribution into historic habitat.

Of particular concern to the Sonoran Pronghorn Recovery team is the possible intrusion of introduced antelope into Sonoran Pronghorn range. As California and Arizona continue to expand antelope populations of other subspecies, suitable sites for reintroducing Sonoran pronghorn may be limited or lost. California is currently considering the Chuckwalla Bench for possible introduction of American pronghorn. Within Arizona, the Papago Indian Reservation no longer contains pronghorn, and due to severe overgrazing by livestock, that area currently offers little suitable habitat. Arizona Game and Fish Department believes that the Boboquiviri Range presents a sufficient geographic barrier to prevent mixing of Sonoran pronghorn with any other subspecies which might be introduced into the Altar Valley.

The Sonoran Pronghorn Recovery Team believes that the Altar Valley offers the best suitable habitat east of current Sonoran pronghorn distributions. They further believe that releases of American or Chihuahuan pronghorn on the fringes of historic Sonoran pronghorn range would leave little or no possibility of expanding the range of the Sonoran pronghorn while maintaining the genetic integrity of the subspecies.

Chihuahuan Pronghorn

Historically, Chihuahuan pronghorn were abundant in southeastern Arizona, southern New Mexico, West Texas, and Chihuahua, Mexico. Unlimited hunting, poaching and intentional eradication efforts totally eliminated this species from southeast Arizona by the 1930s.

The Chihuahuan pronghorn fared only a little better in Texas. According to Hailey (1979), once extensive numbers declined from 1880 until 1920, when they reached low point in that state. In 1924 Nelson conducted a statewide survey and documented that where estimated millions had occurred forty years before, only 2,407 remained. The majority of these were on a few ranches where they had been protected.

Recovery efforts including numerous transplants brought pronghorn in Texas back to about 13,500 in 1978. Roughly 60% of this number occurred in the Trans-Pecos or West Texas Region and were considered to be A. a. mexicana. However, that subspecies is considered rare throughout the rest of its historic range and except for recent transplants, it is absent in Arizona.

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Trevino (1978) estimated that 500-600 pronghorn remained in Chihuahua, Mexico. Dobrott (pers. comm., 1987), reports a remnant population of approximately 200 pronghorn remaining on the Gray and U-Bar ranches in southwest New Mexico.

Early pronghorn transplant efforts by the Arizona Game and Fish Department used A. a. americana stock from northern Arizona. Populations were established from 1943-51 north of Willcox, near Elgin and in the Altar Valley. Substantial populations still exist near Willcox and Elgin. The Altar Valley transplant, based on only eighteen animals, dwindled to a few animals reported in 1977 on the north end of what is now the Buenos Aires NWR. Recent sightings of three or fewer pronghorn have been reported east of Arivaca (USFWS, 1968).

The Arizona Game and Fish Department has been active in attempts to re-establish the native Chihuahuan pronghorn in southeastern Arizona over the past six years. All pronghorn released in Region V (southeast Arizona) during this period were captured and transported from the Trans-Pecos Region of Texas in 1981, 1984, and 1986.

As the result of these efforts, new populations have been established in two areas of historic Chihuahuan pronghorn habitat. An additional transplant in 1986 supplemented an existing population at a third location. In all, about 190 pronghorn were captured and moved since 1981.

The Altar Valley has been considered by the Arizona Game and Fish Department to be the next priority transplant area for Chihuahuan pronghorn. In fact, the Game Branch has proposed completing the Altar Valley transplant in the winter of 1988 with Chihuahuan pronghorn (Inter-office memos Olding, 1985, Brown, 1987, see Appendix 1).

Suitable transplant sites for the native Chihuahuan subspecies are severely limited due to past transplants of the americana subspecies, habitat degradation, development and uncooperative private land owners. Already one of the recent Chihuahuan transplants (Empire Ranch, Sonoita Valley) is in jeopardy due to a housing development and will probably not sustain a viable population for more than ten to twenty years (Olding, pers. comm., 1987). The Buenos Aires Refuge stands out as the most suitable site in southern Arizona to re-establish a secure population of the native Chihuahuan pronghorn.

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BIOLOGICAL CONSIDERATIONS

PRONGHORN BIOLOGY

Habitat Characteristics

Sonoran Pronghorn

Sonoran pronghorn in Arizona are found primarily in the Sonoran desertscrub vegetative community of the Lower Colorado subdivision, the largest and most arid subdivision of the Sonoran Desert. Mean elevations typically range from 400 to 1,600 feet. The Lower Colorado Subdivision contains numerous washes which are dominated by palo verde, mesquite, smoketree, and ironwood (Fig. 4, 5).

Other plants are almost wholly obligate in these wash habitats and include desert willow, desert honeysuckle, and canyon ragweed. Shrubs occurring in minor water courses are catclaw, burrobrush, wolfberry, and desert broom. Sandier soils are characterized by galleta grass and indigo bush. The Creosote-White Bursage Series is the most widespread and important series of the Lower Colorado subdivision. White bursage barely extends above the broad valley floors, while creosote continues to hold a position on the uppermost bajadas and even continues on into the mountains.

The Arizona Upland subdivision of the Sonoran Desert also falls within Sonoran pronghorn range. Here vegetation most often takes on the appearance of a low woodland of leguminous trees with intervening spaces held by several open layers of shrubs and perennial succulents. So important are cacti in this subdivision that Shreve (1964) termed it the stem succulent desert.

The eastern portion of Sonoran pronghorn range is characterized by the Palo Verde-Cacti-Mixed Scrub Series, containing Little Leaf Palo Verde and Saguaro Cactus.

Chihuahuan Pronghorn

Chihuahuan pronghorn in Arizona are found in both semidesert grassland and Chihuahuan desertscrub vegetative communities. Mean elevations range from 2,500 to 5,000 feet. The semidesert grassland adjoins and largely surrounds the Chihuahuan Desert (Fig. 6, 7).

Tobosa grass, along with Black Grama, is the diagnostic grass dominant in semidesert grassland. In some vicinities grasses of the Plains grassland such as Blue, Sideoats, Hairy Grama, Buffalo Grass, Plains Bristlegrass, Plains Lovegrass, and Wolf tail are

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mixed with the semi-desert grasses. Often only the tougher, less palatable grasses such as Hairy Tridens Fluff Grass, Red Threeawn, and Burrowgrass, are present or abundant. Dry tropic stem and leaf succulents such as sotols, bear grasses, agaves, and yuccas are well represented. Important shrub components are mesquite, Mormon tea, false mesquite, catclaw, and desert hackberry.



Figure 4. Sonoran pronghorn utilizing the heavily vegetated Arizona Upland subdivision of the Sonoran Desert. Photo by Ned Smith.

The Chihuahuan desertscrub community is characterized by tobosa and sacaton grasses. Understory associates are a number of yuccas, agaves, and nolinass, as well as ocotillo, catclaw, condalia, and little leaf sumac, along with various opuntias and hedgehog cacti.

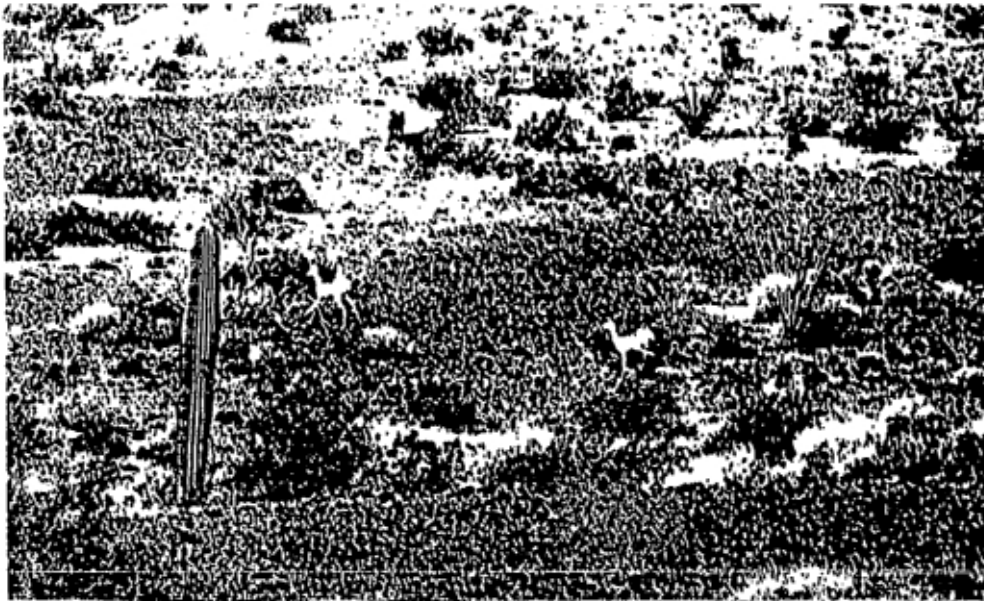


Figure 5. Sonoran pronghorn in typical sparsely vegetated habitat. The Sonoran Pronghorn, Special Report Number 10, page 34.

Buenos Aires NWR

The Buenos Aires NWR is located within the semidesert grassland vegetative community. Elevations range from 3,000 to 4,800 feet. Plants found on the Buenos Aires NWR and known to be utilized in the diets of both Sonoran and Chihuahuan pronghorn are those of the following genera: Ambrosia, Baileya, Krameria, Allonia, Eragrostis, Hilaria, Lycurus, Eriogonum, and Kallstroemia (refer to Brown & Lowe, Biotic Community Map, Appendix 2 of this study).

Climato

Sonoran Pronghorn

The current distribution of Sonoran pronghorn within Arizona occurs within the Sonoran desert, in the hottest and driest

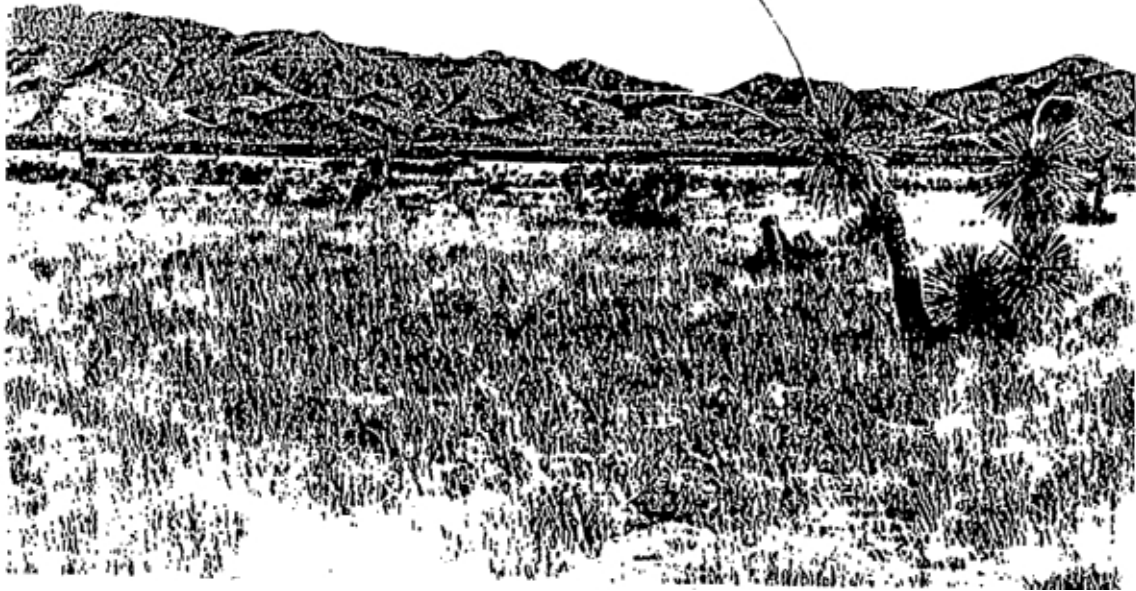


Figure 6. Semidesert grassland in Sulphur Springs Valley, Arizona. Photo by David E. Brown.

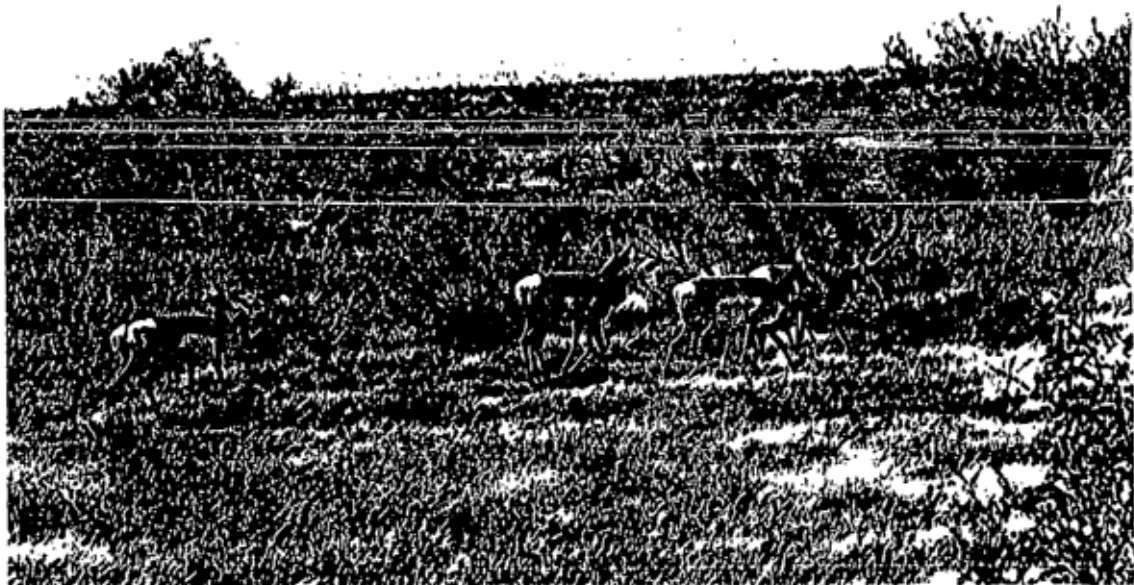


Figure 7. Semidesert grassland near Valentine, Texas. Photo by John S. Phelps.

desert regions of the state. During the hottest part of the year, daily maximums are typically in excess of 100 degrees F. and temperatures as high as 120 degrees F. are not uncommon. Winter months are generally cool with few days of low temperatures below freezing.

The rainfall pattern within Sonoran pronghorn habitat is bi-modal. Summer rainfall results from usually violent thunderstorms of short duration, produced from currents of moisture moving across southern Arizona from the Gulf of California. Winter rainfall is usually less violent, longer in duration, and a result of fronts moving across Arizona from the Pacific Ocean. Approximately half of the annual precipitation is from winter rains. Annual precipitation varies from slightly above four inches in the western portion to over nine inches in the eastern portion of the Sonoran pronghorn range (Appendices 3, 4).

Chihuahuan Pronghorn

Chihuahuan pronghorn habitat lies within the warm temperate semidesert grassland. This region is typically cooler and wetter than the Sonoran Desert.

Rainfall patterns are bi-seasonal, but summer moisture originates from the Gulf of Mexico and is more abundant than in the Sonoran desert. Over half of the total annual average rainfall comes during the April-September period (Table 1).

Buenos Aires NWR

Rainfall patterns of the lower Altar Valley are similar to patterns of areas where Chihuahuan pronghorn now occur in Mexico and New Mexico.

Breeding

Sonoran and Chihuahuan pronghorn have adapted to the climatic conditions in their respective ranges, particularly with respect to breeding. For example, fawning occurs during seasons of maximum nutrition and cover. As Sonoran pronghorn reproduction is timed to take advantage of spring vegetation resulting from winter rains, Chihuahuan pronghorn are likewise keyed to spring-summer vegetation responses.

Sonoran Pronghorn

Breeding chronology of Sonoran pronghorn is somewhat different from that of other antelope. Rutting activity begins in mid-July

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Table 1. Divisional and Selected Station Long-term Precipitation averages (1931-80).

<u>Divisional</u>	<u>April-Sept.</u>	<u>%</u>	<u>Oct.-Mar.</u>	<u>%</u>	<u>Total</u>
SW Arizona	1.89	42	2.58	58	4.47
SE Arizona	8.26	60	5.52	40	13.78
SW New Mexico	6.56	64	3.74	36	10.30
W. Texas	8.68	71	3.48	29	12.16
<u>Selected Stations</u>					
Ajo, AZ	4.61	53	4.01	47	8.62
Anvil Ranch, AZ	6.90	61	4.36	39	11.26
Sasabe, AZ	8.88	55	7.26	45	16.14
Lordsburg, NM	6.22	60	4.18	40	10.40
Alpine, TX	11.43	77	3.40	23	14.83

and continues to September, coinciding with the summer monsoon season of the Sonoran Desert. Births normally begin in mid-March, though fawns have been observed as early as February and as late as May. Spring parturition coincides with temperate weather and flushes of succulent forage.

Chihuahuan Pronghorn

The Chihuahuan pronghorn's breeding chronology varies in different portions of its range, possibly in response to the different climate patterns. In the Trans-Pecos region of Texas, rutting activity occurs from mid-August to early October. Fawns are born from early May to early June, coinciding with spring forage.

On the Gray and U-Bar ranches of southern New Mexico, Dobrott (pers. comm., 1987) reports observing the first fawns in late July with the peak fawning period in early to mid-August. He believes that parturition is keyed to forage production resulting from the summer monsoon season, a possible advantage to fawn survival in that region.

In Chihuahua, Mexico, Trevino (1978) reports no observation of fawns until July, suggesting that the breeding season there coincides with that in southern New Mexico.

In Arizona, the peak fawning period for transplanted Chihuahuan pronghorns from the Trans-Pecos region is from mid-May to mid-June (Olding, pers. comm, 1987), the same as in their home area, despite the different climate pattern. Likewise, American pronghorns introduced into southeastern Arizona in the 1940s and 1950s showed no substantial change in fawning period.

Home Range

Current studies indicate that home range size is probably a function of habitat, forage and water availability, and weather, rather than subspecies.

Home ranges of Sonoran pronghorn are quite variable and dependent upon sex. Home ranges of from 15.4 sq. mi. to over 463.2 sq. mi. have been observed (AGFD, 1987). Within the northwestern portion of their range, which is dry and sparsely vegetated with poor water availability, Sonoran pronghorn have larger home ranges than in the southeastern portion, which is wetter and more densely vegetated with more permanent water.

According to Buechner (1950), Texas Chihuahuan pronghorn movements of five to ten miles were related to weather, fawning seasons, and grazing conditions.

Pronghorn movements in southern Arizona have never been documented through observations of marked animals with the exception of recent transplants. Movements at those sites are comparable to the observations made by Buechner.

Food Preferences

Sonoran pronghorn are known to feed on a variety of vegetation. Forty-nine plant species with a relative percent density of 0.1% were found in feces analysis (AGFD, 1987). The diet of the Sonoran pronghorn using all fecal samples available from 1974-78 consisted of 69% forbs, 22% shrubs, 7% cacti and 0.4% grasses. Other antelope within the southwestern United States were found to have similar diets.

Chihuahuan pronghorn food habits data indicate that they strongly select for abundant and diverse forbs when available. In Texas, forb use totaled 63% annually and was highest from September to February. Grasses generally comprise 5-10% of the annual total, with the preponderance of use during the spring.

In New Mexico, browse use was highest in the fall and winter, according to Russell (1964). Hailey (1979) indicated it to be the highest in June to August in Texas. Browse use is probably

highest when few forbs are available.

In general, then, areas with an abundance of forbs and with high diversity of shrubs, and grasses should provide optimum forage for both subspecies of pronghorn.

Water Requirements

The Sonoran pronghorn survives for extended periods in the absence of free water. In fact, there is no documented evidence that Sonoran pronghorn readily take free water. However, recent studies found radio-collared Sonoran pronghorn closer to water sources than would be expected randomly (AGFD, 1987). Individual collared animals averaged 1.1 to 5.7 miles from a known water source. Sonoran pronghorn appear to exhibit seasonal movement in relation to water sources. The average distance to a known water source per month varied from 2.2 miles during summer months prior to monsoons to 4.5 miles in May, prior to critical drought months.

Water is considered essential for American and Chihuahuan pronghorn survival except during periods of extensive growth of succulent forbs. Beale and Smith (1970) measured water use of pronghorns in western Utah from 1962-1965. They found that pronghorn did not utilize readily available water when forbs were abundant, with moisture content in excess of 75%. During periods of use, pronghorn averaged three quarts of water per day in summer when forage was dry and about two quarts per day in October prior to the first snow. The highest intake observed was less than one gallon per day.

Most pronghorn researchers and managers agree that adequate water sources are essential to optimum Chihuahuan antelope population levels, and that one reliable source every three to four miles is sufficient. Pronghorn will take water from a variety of troughs and catchments.

BUENOS AIRES NWR SUITABILITY ANALYSIS

To determine habitat suitability of the Buenos Aires NWR for pronghorn, the study team consulted the Arizona Game and Fish Department's Guide to Formulating Pronghorn Antelope Transplant Priorities in Arizona (Appendix 5). It is used primarily by the Department to compare potential transplant sites within Arizona. Ratings by several evaluators are averaged and compared with ratings for other areas to determine transplant priorities.

To establish a rough evaluation of an area's relative suitability for pronghorn transplant, the method includes 12 criteria, each

with a rating of 1 to 4. The maximum possible score is 48.

After familiarizing themselves with the refuge by ground and air, the study team applied the method to an analysis of pronghorn habitat. This evaluation resulted in a rating of 36 for current conditions. A potential score of 43.5 was predicted, assuming various habitat improvements are made.

Table 2. Current and Potential Pronghorn Habitat Suitability Ratings for Buenos Aires NWR, 1987.

<u>Category</u>	<u>Current Rating</u>	<u>Potential Rating</u>
A. Historic Occurrence	2.5	
B. Land Status	3.5	4.0
C. Topography	3.0	
D. Cover	2.5	4.0
E. Range Conditions	2.5	4.0
F. Presence of Other Ungulates	4.0	
G. Fences	3.0	4.0
H. Seasonal Availability of Habitat	4.0	
I. Available Water	3.0	4.0
J. Habitat Discreteness	2.5	4.0
K. Human Disturbance	3.0	
L. Range Expansion Potential	2.5	4.0
Totals	36.0	43.5

Habitat suitability is only roughly estimated in this process. Key features for pronghorn are abundance and diversity of forbs, grasses, shrubs, and trees; abundance and diversity; number and distribution of available water sources; canopy cover and height; fence types; and predator populations. The team believes that further study of these factors should be conducted prior to release of pronghorn.

We estimate that the Buenos Aires NWR contains approximately 130 sections of vegetation types potentially suitable for pronghorn. With management, the entire refuge could be considered potential pronghorn habitat. In addition, there are substantial areas off the refuge to the north and east for additional population expansion. The portions of the refuge best suited for release are areas A and B (Fig. 8). Area A is best suited for initial release, while Area B should undergo a prescribed burn prior to a release.

Based on Southern Arizona's average pronghorn densities in other populations, it is reasonable to anticipate a population of 150-200 pronghorn primarily centered on the refuge, if improvements in the habitat are made.

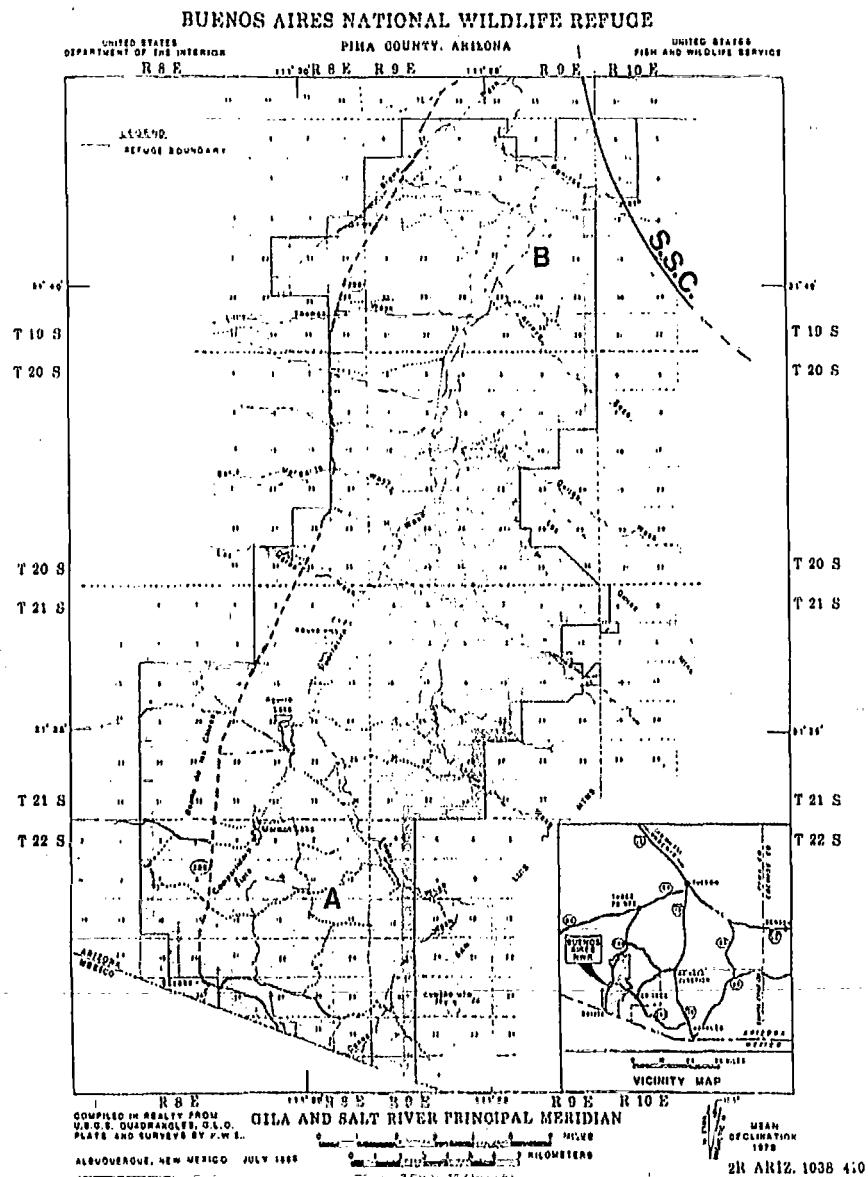


Figure 8. Map of Buenos Aires NWR showing potential pronghorn release areas A and B and the proposed route of the superconducting supercollider.

REINTRODUCTION SCENARIOS

AVAILABILITY

Sonoran Pronghorn

Because the existing population of Sonoran pronghorn is extremely small, the number of animals available for transplant or reintroduction efforts would be limited. Therefore a successful program would require captive propagation from animals captured from the current population.

Due to the endangered status of the Sonoran pronghorn, the capture and removal of any individuals from the current population would require a no-jeopardy opinion subsequent to compliance with The Endangered Species Act.

Initially, six to ten pronghorn would be captured from the current population and relocated to a breeding enclosure at Buenos Aires NWR. In order to ensure genetic integrity, additional animals would be captured and added to the captive herd as available.

Estimates of the time required for the captive herd to expand to at least forty animals range from four to seven years. With no mortality and every doe bearing two fawns each reproductive year, the herd would exceed forty in the fourth year. With 10% mortality and an annual average of one fawn per doe, it would take seven years. At that time, the herd could be free-released on the refuge.

For the first two years after release, Sonoran pronghorn should be contained and monitored within the boundaries of the refuge. Monitoring would allow the USFWS to implement any needed predator control, conduct systematic intensive surveys to determine population status and integrities, and determine seasonal habitat selection. This would also facilitate removal of the Sonoran pronghorn if for some reason the transplant should fail.

Chihuahuan Pronghorn

For Chihuahuan pronghorn, the following options are available:

1. Arizona Game and Fish Department has a continuing cooperative program with Texas Parks and Wildlife Department to supply each other with surplus Chihuahuan pronghorn and desert bighorn for restocking of native species in available habitat.

In recent years, Texas has been actively attempting to reestablish bighorns from Arizona stock. In return, they have been very cooperative in providing Chihuahuan pronghorn from the

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Trans-Pecos Region for Arizona's pronghorn recovery program. These pronghorn have proven their ability to thrive in southeast Arizona based on experience with the Empire Ranch Transplant in 1981. It should be possible to obtain about 100 pronghorn in 1987 and/or 1988 to reestablish another population in Arizona.

2. A preferable source of Chihuahuan pronghorn may be available from the Gray Ranch population in southwestern New Mexico. The climate of this area is similar to that on the Buenos Aires NWR. However, it is likely that fewer pronghorn would be available from this source, perhaps thirty to fifty animals initially. Discussions on this subject have not yet been initiated with the New Mexico Game and Fish Department.

3. As described in the "Current Status" section of this report, the Arizona Game & Fish Department has been active in reestablishing Chihuahuan pronghorn in southeastern Arizona during the past six years. The resulting populations may provide another possible source for transplant stock, depending on surplus availability.

PREPARATIONS FOR RELEASE

Fencing

Sonoran Pronghorn

A Sonoran pronghorn propagation program at Buenos Aires NWR would require extensive preparations. A site of at least 700 acres in prime pronghorn habitat, fenced to house pronghorn safely and exclude predators, would be necessary. Removal of all predators from the enclosure prior to release and subsequent predator monitoring would be essential.

Vegetative transects would be established within the enclosures and closely monitored. The forage base of the enclosure would have to be suitable for six-ten pronghorn during the first year, and for increasing numbers each year, to a maximum of at least forty in the fourth year. Supplemental feeding and watering may be necessary as the captive herd nears suitable size for free release.

When the herd is ready for release, the enclosure could be partially dismantled and the animals would then be released. All additional fencing on the Buenos Aires NWR should be inspected and modified where necessary to prevent impedence to pronghorn movements within the refuge and to contain them within refuge boundaries.

Not being jumpers, pronghorn generally negotiate fences by going under the bottom strand of wire. Researchers have determined

that a wire-strand height of 16 inches above the ground is sufficient to allow passage of pronghorn. Most four-strand barbed-wire fences allow enough clearance and can still retain livestock. The many five-strand fences on the refuge, however, may have to be altered to accommodate pronghorn.

Net-wire or sheep fences are impenetrable barriers to pronghorn. Only one such fence is known to be on the refuge, and it could easily be removed or breached to allow passage of pronghorn.

Chihuahuan Pronghorn

Fencing preparations for Chihuahuan pronghorn would be simpler. It will be necessary to further evaluate and in some cases modify pasture fences on the refuge to allow unimpeded expansion and movement of the pronghorn, as described above.

Containment of a Chihuahuan pronghorn population to the refuge would not be a desirable objective, except for the approximately five miles of U.S./Mexico boundary. It would not be advisable to allow either subspecies to move freely out of U.S. protection and management control at this time. Southward movement should be impeded by fortification of the international boundary fence and perhaps also an existing refuge pasture fence a minimum of one mile north of the border. This would also lessen the possibility of poaching.

Water

For Chihuahuan pronghorn, the availability of water is of prime importance. Although many earthen tanks exist on the refuge, their permanency depends on runoff and therefore is not assured. Maintenance and possibly expansion of existing permanent watering systems will be necessary to insure that permanent reliable water sources are easily accessible to pronghorn.

Further analysis of permanent water sources on the refuge will be necessary prior to any pronghorn free release. If water sources are insufficient to sustain an abundant population, the Arizona Game & Fish Department would recommend and cooperate with the U.S. Fish & Wildlife Service in planning and constructing additional sources.

CAPTURE

Sonoran pronghorn captures would be conducted during late October, so that does would already be bred, the captures would not interfere with rutting activity, and temperatures would be favorable. Capture would be accomplished with hand-held net guns fired from jet-powered helicopters. The animals would then be sling-carried to a staging area for transport to the refuge.

For Chihuahuan pronghorn, the drive-trap capture method has been used successfully. In this method, a helicopter and ground personnel drive the pronghorn into a wing fence that leads into a net corral. There they are hand-caught, eartagged, inoculated, and loaded into transport trailers.

Capture would be conducted by the state wildlife agencies involved, depending on the source site. Past captures conducted cooperatively with Texas Parks and Wildlife have been highly successful. Capture mortality has been slight, generally about 3-5%. Experienced personnel will prepare a capture, transport and release plan and conduct the operation in cooperation with U.S. Fish and Wildlife Service.

The number of animals to be captured will depend on the subspecies to be transplanted. The initial number of Sonoran pronghorn for propagation would be six to ten animals. Depending on the source, the number of Chihuahuan pronghorn for direct release would be fifty to one hundred animals.

MANAGEMENT

Predator Control

Some predator control will be necessary to ensure maximum survival of either transplant candidate subspecies. Control activities should take place prior to and possibly during the peak fawning period.

For Sonoran pronghorn, initial control efforts will involve removal of all predators from the breeding enclosure and maintenance of a predator-resistant fence. Prior to release of the herd from the enclosure, additional control measures may be necessary.

Although predator trapping can be used where appropriate, the preferred control method is aerial gunning from a helicopter. Control efforts should be conducted annually until pronghorn population numbers exceed 200.

The number of pronghorn released will determine the duration of predator control. With adequate control, the annual fawn survival should be 60-70 fawns per 100 does, allowing the population to double in about three years. Without predator control, the transplant would have to be much larger, preferably over 100 animals.

SURVEYS

For either subspecies, intensive population surveys would be necessary.

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SURVEYS

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Surveys for Sonoran pronghorn within a breeding enclosure could be conducted only from the ground. After the population is free-released within the refuge boundaries, ground and aerial surveys would be required. Ground observations would be made intermittently throughout the year but should be intensive during peak fawning within preferred fawning habitat. Aerial surveys would be conducted biannually, once during mid-winter to determine total population size and again during late spring to determine fawn recruitment. Should Sonoran pronghorn become free released throughout the Altar Valley, efforts would be lessened on ground surveys but increased during aerial surveys. Aerial surveys would be conducted biannually during the same time intervals but would be expanded to include pronghorn habitat throughout the Altar Valley.

Hunting

Due to the endangered status of Sonoran pronghorn, they could not be hunted until that status is removed. The endangered status could be petitioned for delisting if Sonoran pronghorn become successfully established throughout the Altar Valley in excess of 300 individuals, without a substantial decline in the current population. If this occurs, a limited hunt may be possible.

No stipulations against Chihuahuan pronghorn hunting exist, although no hunts have yet been authorized in any of the three Chihuahuan populations now being established. However, hunting remains a viable and desired objective of Chihuahuan transplants. Arizona permits extremely conservative buck-only pronghorn hunting in twenty-two hunt areas, with 818 permits issued in 1986. An indication of the demand for pronghorn hunting is seen in the number of first choice applicants for these permits, which totaled 8,617 in 1986. Arizona Game and Fish Department would cooperate with refuge personnel in establishing hunt permits, if the population should achieve sufficient numbers to authorize them.

Habitat Manipulation

A variety of methods can be implemented on the refuge to improve and increase antelope habitat. In most cases, the same habitat diversity objectives as for masked bobwhite apply to pronghorn.

Prescribed burning is probably the most effective method for maintaining "openness", creating plant diversity and stimulating forb growth.

The area of the refuge which the teams considers currently optimal for pronghorn release was greatly improved by a 10,000-acre wildfire in May, 1986. Other potential habitat could be similarly improved by fire. So impressive are the results of this fire that we recommend prescribed burning of potential release areas on the north end of the refuge prior to pronghorn release.

Grazing is another method that can be used to stimulate forb growth, but livestock competition for water and reduced fuel loads for carrying effective fires may outweigh the benefits of this method.

Conflicts

As numbers and herd integrity improve after Sonoran pronghorn are free-released on Buenos Aires NWR, pronghorn should be allowed to expand throughout the Altar Valley. This would require cooperation of local ranchers and landowners. Any conflicts would be addressed by individual discussion and compromise.

It is possible, though unlikely, that a limited number of americana pronghorn are currently free-roaming in the Altar Valley. After Sonoran pronghorn are free-released, these two subspecies might intermix, affecting genetic integrity of the Sonoran subspecies. Prior to the release, therefore, any free-roaming americana pronghorn should be located. If interbreeding appears likely, the situation should be rectified.

Perhaps more significant, the Arizona Game and Fish Department believes that the presence of endangered Sonoran pronghorn on the refuge may conflict with the hunting of other species such as deer and javelina (Ron Olding, pers. comm., 1987).

One of the proposed locations for the Department of Energy's superconducting supercollider project utilizes sections 6 and 7 of the northwest corner of the refuge (Fig. 8). If this location is selected, it could have some impact on the pronghorn.

No habitat management conflicts between masked bobwhite and pronghorn are foreseen. In fact, such procedures as controlled burns, brush control, and predator control which are or have been considered for the benefit of the masked bobwhite will also benefit both Sonoran or Chihuahuan pronghorn. However, the addition of another endangered species to the refuge may result in more complex administrative management problems.

DISCUSSION

The study team established that pronghorn of some form did inhabit the Altar Valley at one time. However no historical evidence exists to substantiate which subspecies, A. a. sonoriensis or A. a. mexicana occurred on the refuge. Without historic evidence, the decision must be based on biological factors.

In terms of "biological soundness", it appears that A.a. mexicana is the most suitable alternative for the current refuge environment. Analysis of habitat and climate indicate that Buenos Aires NWR conditions are much closer to those of A. a. mexicana habitat than that of A. a. sonoriensis. Forage quantity is greater and the climate is wetter and cooler than where existing Sonoran pronghorn populations persist. This does not mean, however, that Sonoran pronghorn would not thrive equally well on the refuge.

An introduction of Chihuahuan pronghorn would probably be easier than Sonoran from an administrative standpoint. Extensive transplant experience in western states indicates that the much larger number of available antelope would greatly increase chances of establishing a new population. Costs of facilities, personnel, predator control, and monitoring would be significantly lower for the Chihuahuan pronghorn alternative. In addition, Chihuahuan pronghorn would be expected to provide a small huntable population within five years.

On the other hand, some researchers believe that reintroduction of Sonoran pronghorn into the Buenos Aires NWR may be one of the last chances to expand numbers of this endangered animal to recovery levels. In addition, a population on Buenos Aires NWR would serve as a second "insurance" population in case of a disease outbreak or other catastrophe in the existing population.

So little is known about the habitat needs of the Sonoran pronghorn that predicting the success of a propagation and transplant attempt is difficult. Current habitat conditions make it difficult to draw conclusion as to the true extent of its former range. Whether or not there remains enough potential habitat west of the Baboquivari Peak to allow for recovery is debatable.

An objective of the recovery plan for Sonoran pronghorn calls for a population of 300 animals in the U.S. The present range has not maintained more than 100 pronghorn in historic times. No data have been collected which establish the limiting factors of the relatively extensive current range. The team agrees that additional studies of this subspecies are imperative.

Is the Buenos Aires NWR the only remaining option for the recovery of A. a. sonoriensis? Would A. a. sonoriensis thrive

in the Altar Valley, even though it is adapted to a much different biotic community and climate regime? These questions are unanswerable at this time, but deserve consideration.

After extensive discussion and consideration of all the data presented in this report, the study team was unable to reach a consensus about which subspecies would be preferable for a reintroduction onto the refuge. Three members believe A. a. mexicana to be preferable and two support an A. a. sonoriensis transplant. We all agree, however, that the refuge is suitable for pronghorn and that either subspecies could probably do well there.

Regardless of the subspecies chosen for reintroduction, a detailed pronghorn management plan should be developed. We recommend that a study such as the one described in the "Buenos Aires NWR Suitability Analysis" section of this report be conducted prior to any introduction, in order to obtain additional information necessary for developing an effective management plan.

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Appendix I

Arizona Game and Fish Department Inter-office Memo

ARIZONA GAME AND FISH DEPARTMENT

INTER-OFFICE MEMO

TO: Ray Lee

FROM: Ron Olding

RJO

SUBJECT: Bighorn and Antelope Potential Transplant Sites

DATE: February 27, 1985

Below are listed potential transplant sites for bighorn or antelope within our Region. We are most interested in pursuing for fall 1985 additional pronghorn (Chihuahuan) for the San Bernardino and bighorn for the northwest Galupio Mountains.

UNIT	ANTELOPE	PRIORITY	BIGHORN	PRIORITY
29	Krontz - SE side	L	Chiricahuas	M
30A	*S.B. Valley	H	(continuing) Pedregosa Mtns	I
	N Douglas Airport	M		
	Chiricahua Mon. - Pat Hills	M		
30B	Sunizona area	L		
31	Circle I Hills supplement	M		
32			*NW Galupios-cont.	H
33			Pusch Ridge-supplement	M
34A				
34B				
35A				
35B				
36A	Altar Valley	M	Cerro Colorados	M
36B	" "	H	Tumacacoris	MH
36C	" "	M	Coyotes	M
37A			Picacho Mtns	M
37B	Antelope Peak	L		
37B	Mineral Mountains	MH		

ARIZONA GAME AND FISH DEPARTMENT
INTER-OFFICE MEMO

503

TO: Bruce D. Taubert, Chief
Wildlife Management Division

FROM: David E. Brown, Supervisor
Game Branch

SUBJECT: Big Game Transplant Schedule

DATE: February 20, 1987

For Your Info

The Game Branch proposes the following big game transplant schedule for 1987 and 1988:

BIGHORN SHEEP

<u>Transplant Period</u>	<u>Source</u>	<u>Destination</u>
Summer, 1987 (drop net)	Region III	Colorado (20) Unit 16B - Needles Peak (15)
Winter, 1987 (net-gun, et al)	Region IV	Unit 39 - Gila Bend (15-20) Unit 24A - Superstitions (15-20) or Unit 28 - Gila Box ¹
Summer, 1988 (drop net)	Region III	Unit 12A - Hack's Canyon (15-20)
Winter, 1988 (net-gun, et al)	Region IV	Texas (10-15) Unit 24A - Superstitions (20-25) or Unit 28 - Gila Box

ANTELOPE

<u>Transplant Period</u>	<u>Source</u>	<u>Destination</u>
Winter, 1987	Colorado	Unit 13A - Strip (50-60) Unit 20B - Hillside (40-50)
Winter, 1988	Texas	Unit 36C - Altar Valley (100-110)

¹ Game Branch proposes La Barge Mountain in the Superstition Mountains as first priority.

Appendix 2

**Biotic communities associated with Pronghorn
distribution in the Southwest.
(Biotic Communities of the Southwest, 1980, Brown and Lowe).**

BIOTIC COMMUNITIES OF THE SOUTHWEST

by David E. Brown and Charles H. Lowe
AUGUST 1980

TUNDRA FORMATION

ALPINE TUNDRAS FOREST FORMATION

122.4 PETRAN SUBALPINE CONIFER FOREST

122.5 SIERRAN SUBALPINE CONIFER FOREST

122.6 PETRAN MONTANE CONIFER FOREST

122.7 SIERRAN MONTANE CONIFER FOREST

122.8 SINALOAN DECIDUOUS FOREST

WOODLAND FORMATION

122.9 GREAT BASIN CONIFER WOODLAND

122.9 MACLEAN EVERGREEN WOODLAND

122.9 CALIFORNIAN EVERGREEN WOODLAND

SCRUB FORMATION

122.9 GREAT BASIN MONTANE SCRUB

133.1 CALIFORNIAN CHAPARRAL

133.2 CALIFORNIAN COASTAL SCRUB

133.3 INTERIOR CHAPARRAL

133.3 SINALOAN THORN SCRUB

GRASSLAND FORMATION

133.4 SUBALPINE GRASSLAND

133.5 PLAINS and GREAT BASIN GRASSLAND
133.5 PLAINS GRASSLAND with SHINNERY OAK

133.7 CALIFORNIAN VALLEY GRASSLAND

133.8 SEMIDESERT GRASSLAND

DESERT SCRUB FORMATION

133.1 GREAT BASIN DESERT SCRUB

133.1 MOHAVE DESERT SCRUB

133.2 CHIHUAHUA DESERT SCRUB

SONORAN DESERT SCRUB

134.11 Lower Colorado River Subdivision

134.12 Arizona Upland Subdivision

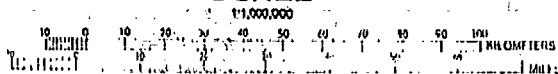
134.13 Plains of Sonora Subdivision

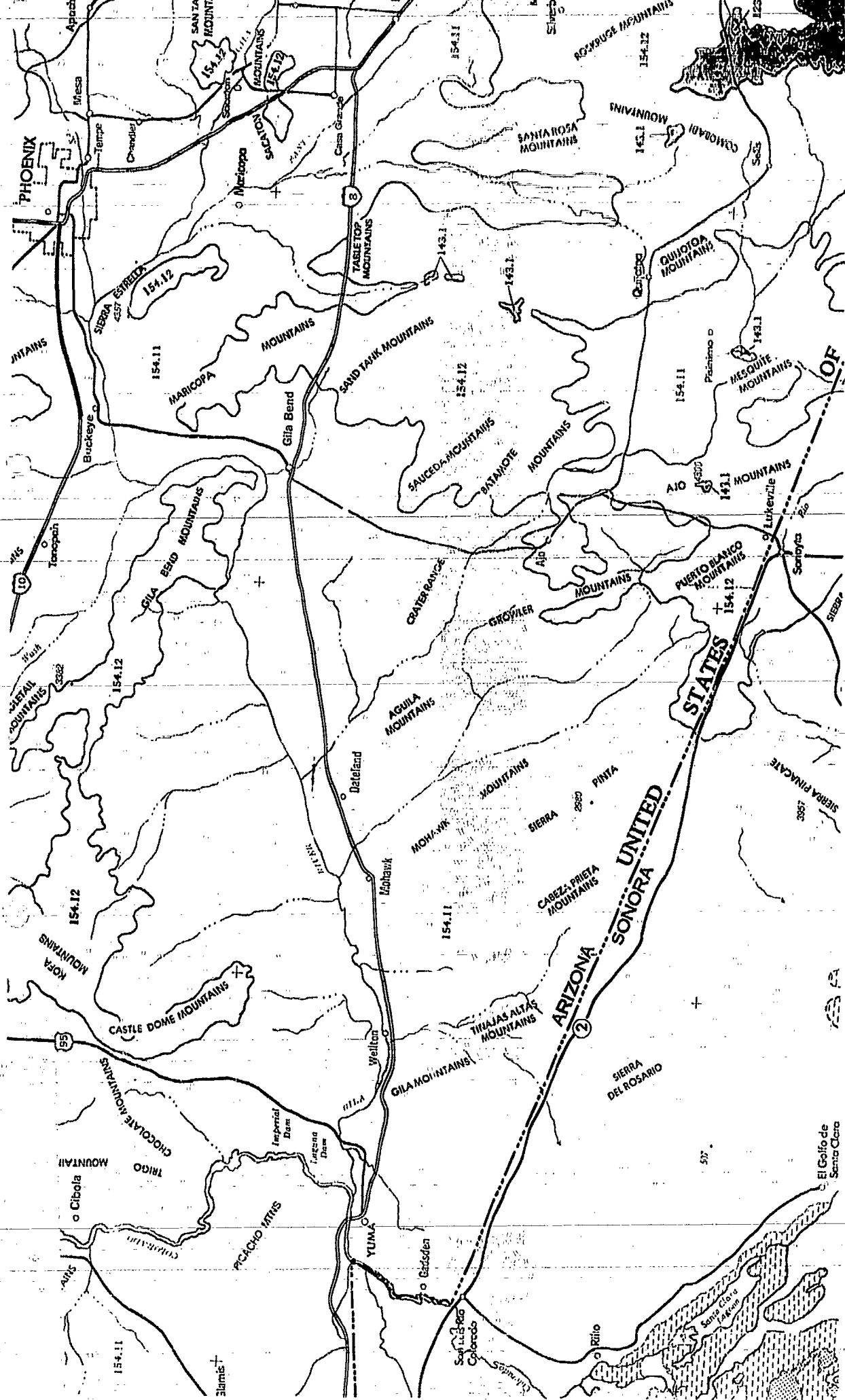
134.14 Central Gulf Coast Subdivision

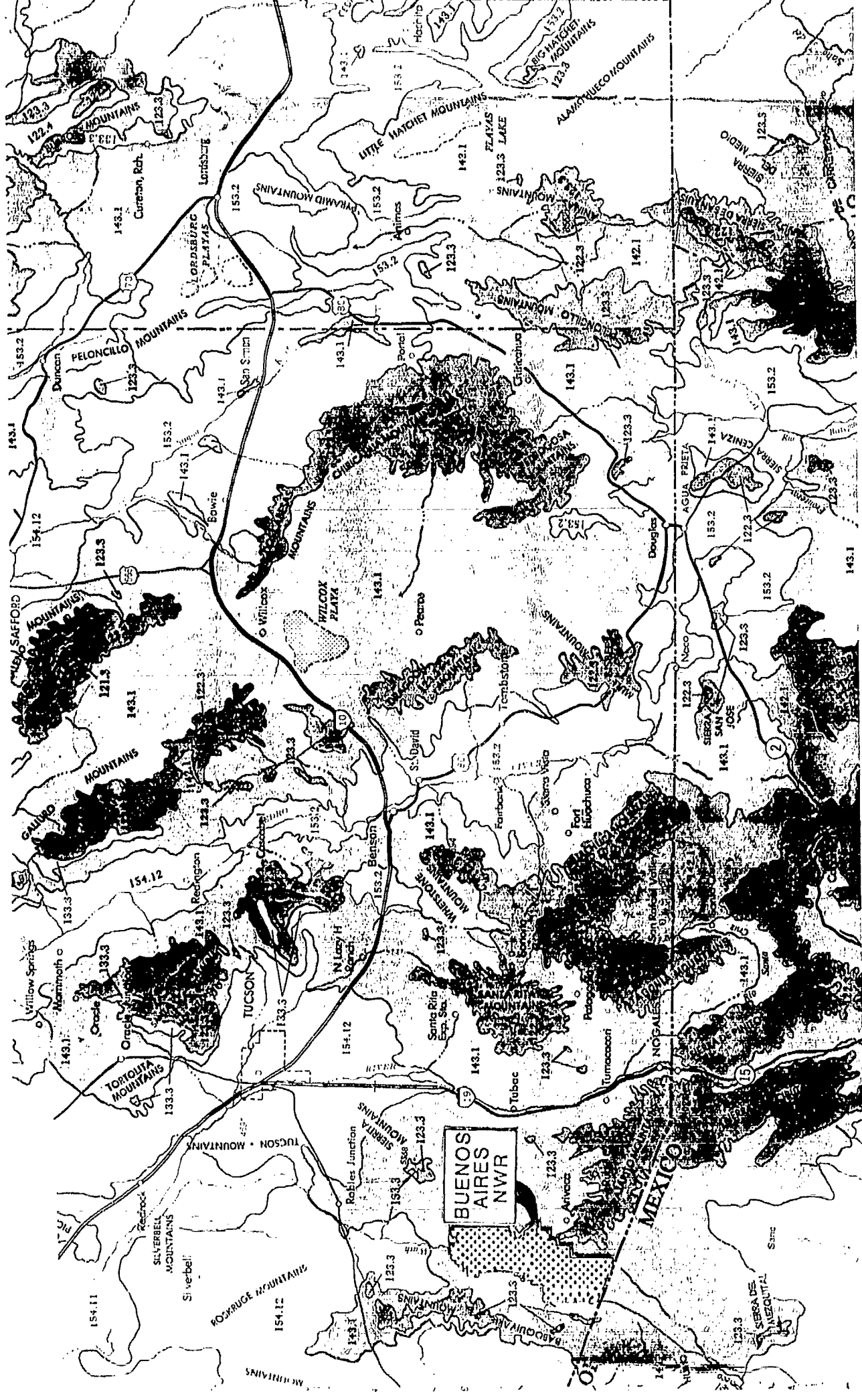
134.15 Vizcaino Subdivision

134.16 Magdalena Subdivision

SCALE



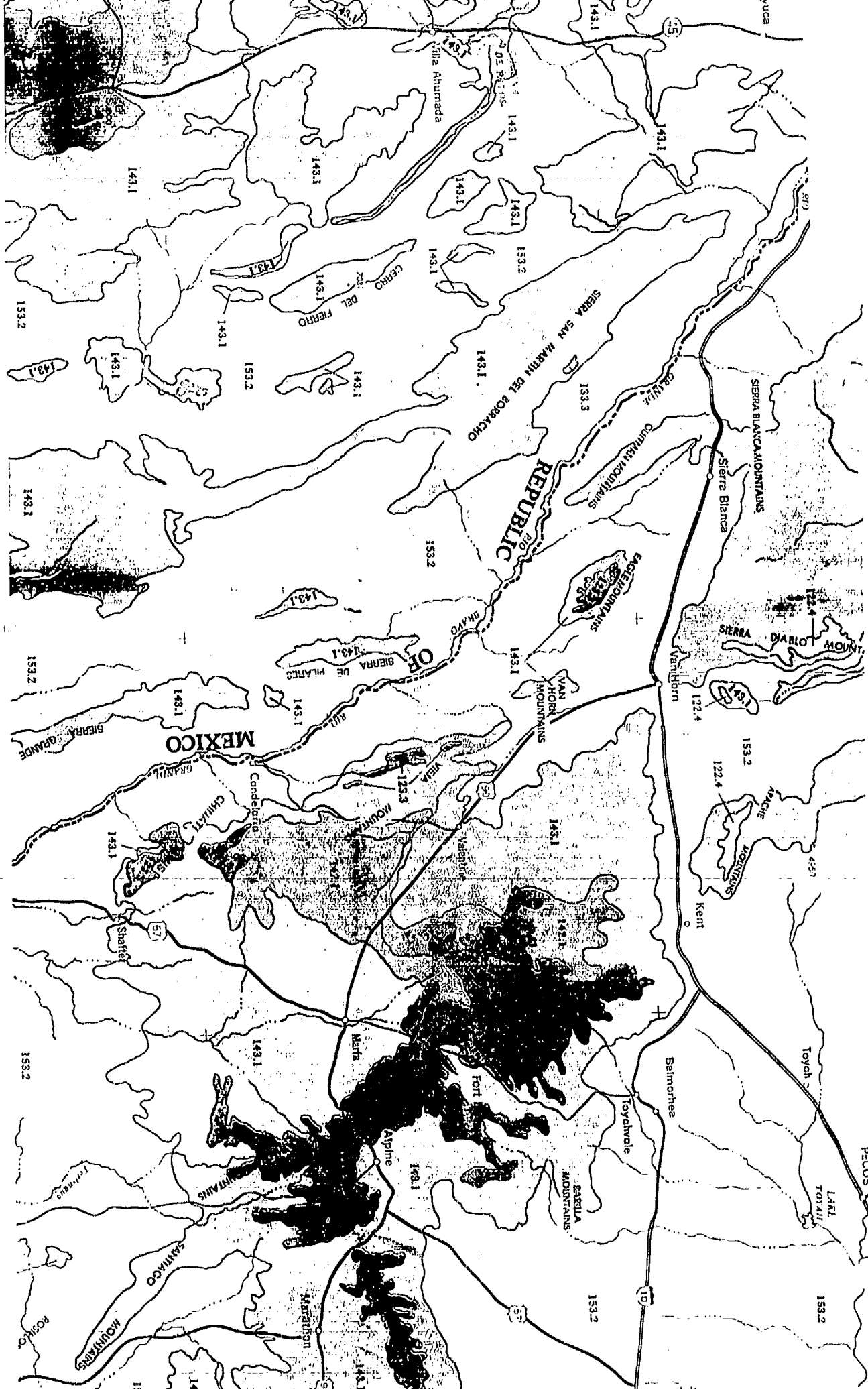




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LEGIBLE. THEREFORE THE QUALITY OF THE
MICRO IMAGE IS BELOW STANDARDS.**

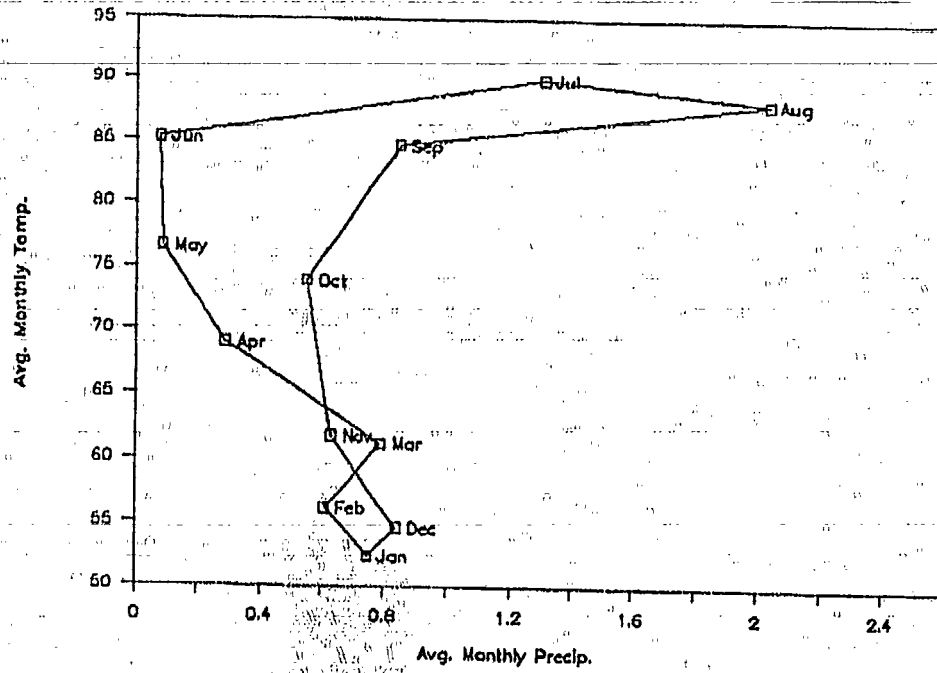
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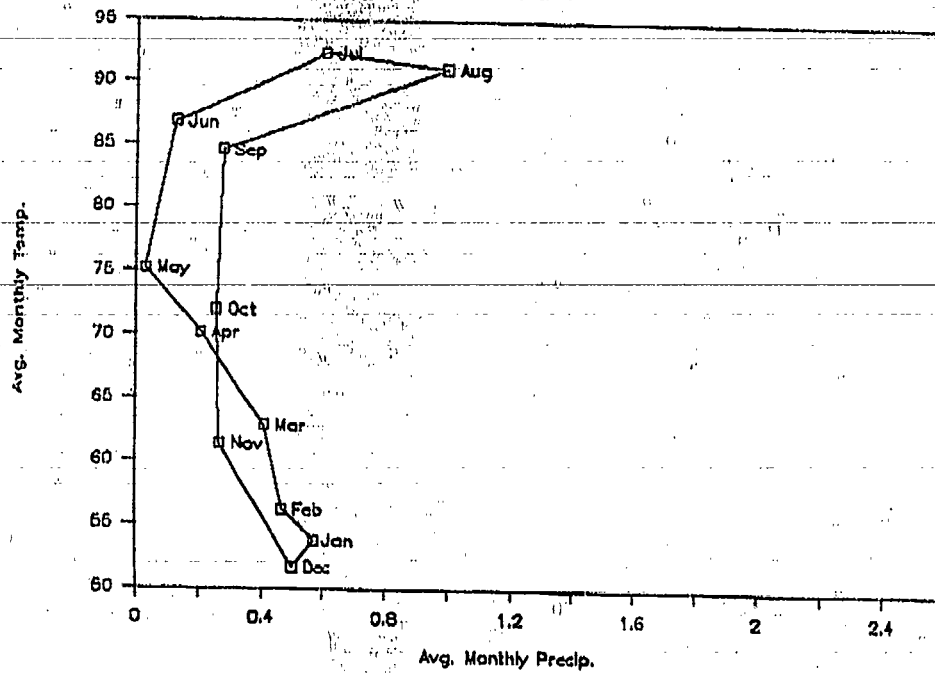
Appendix 3

Climographs for selected stations long-term
precipitation averages (1931-1980).

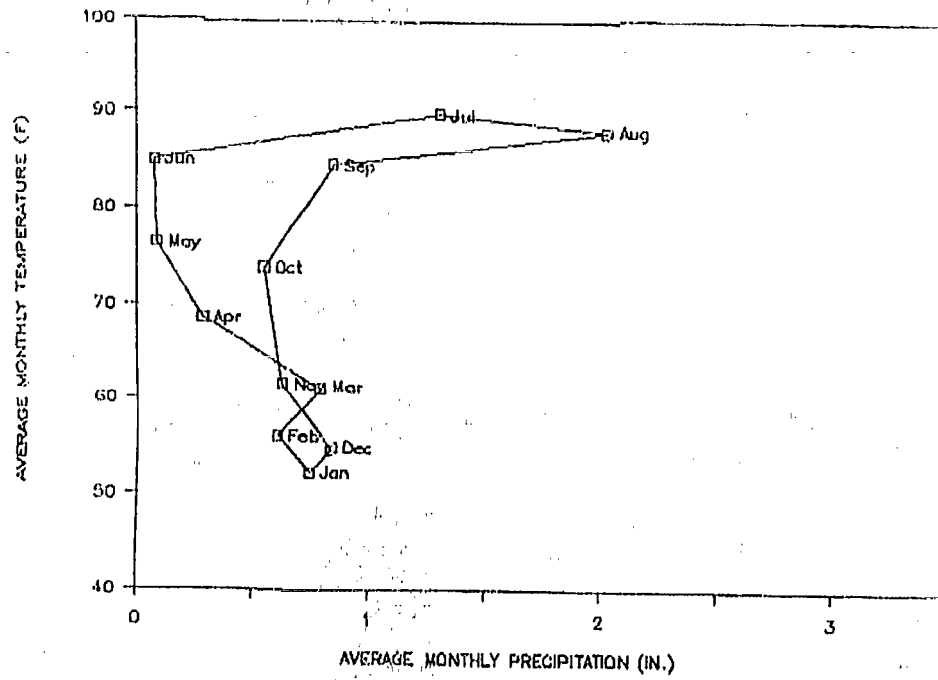
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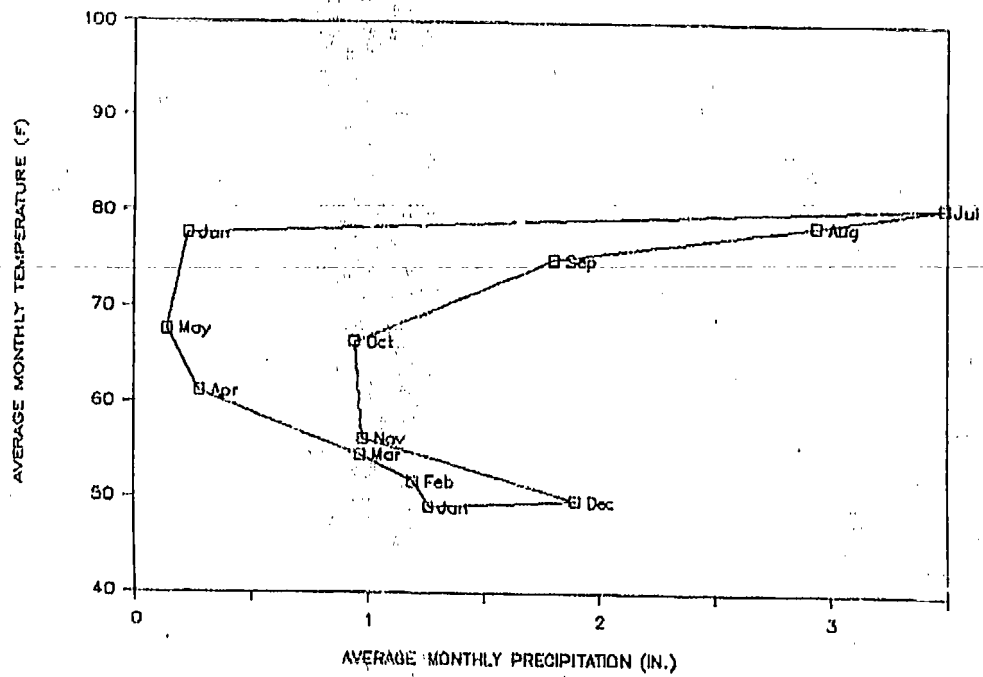
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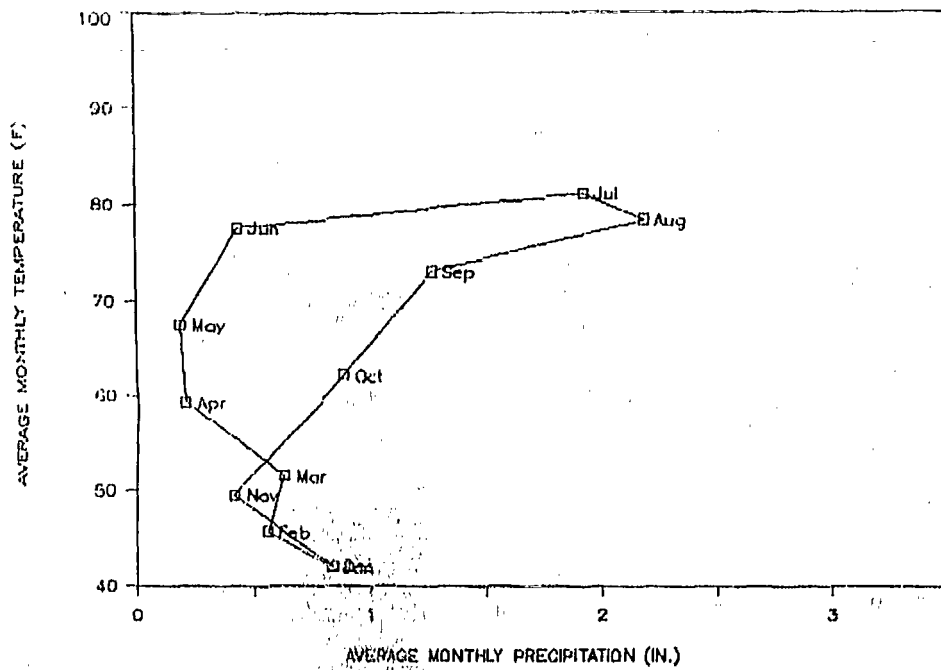
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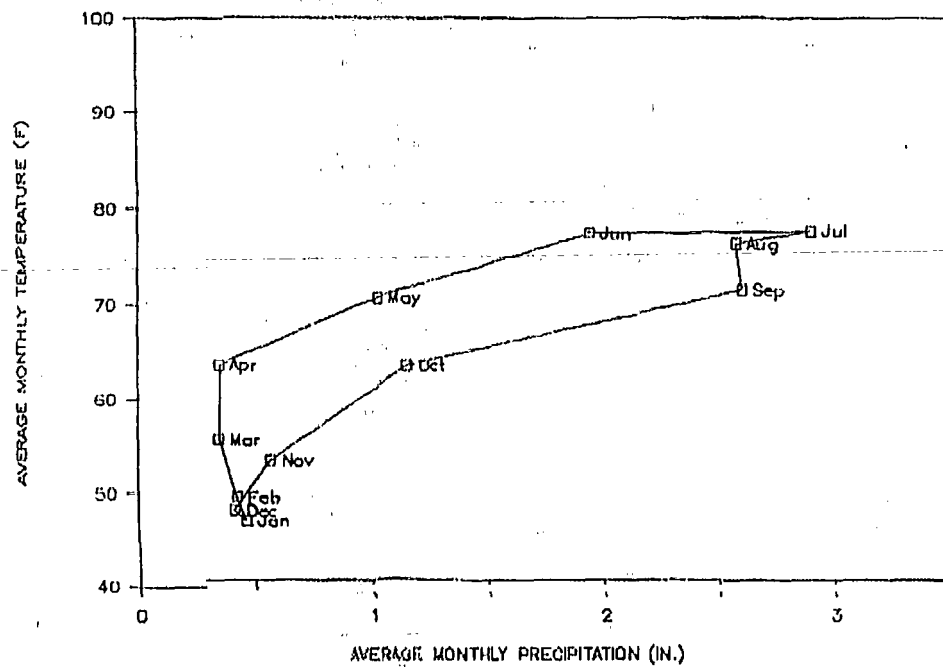
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LORDSBURG, NM

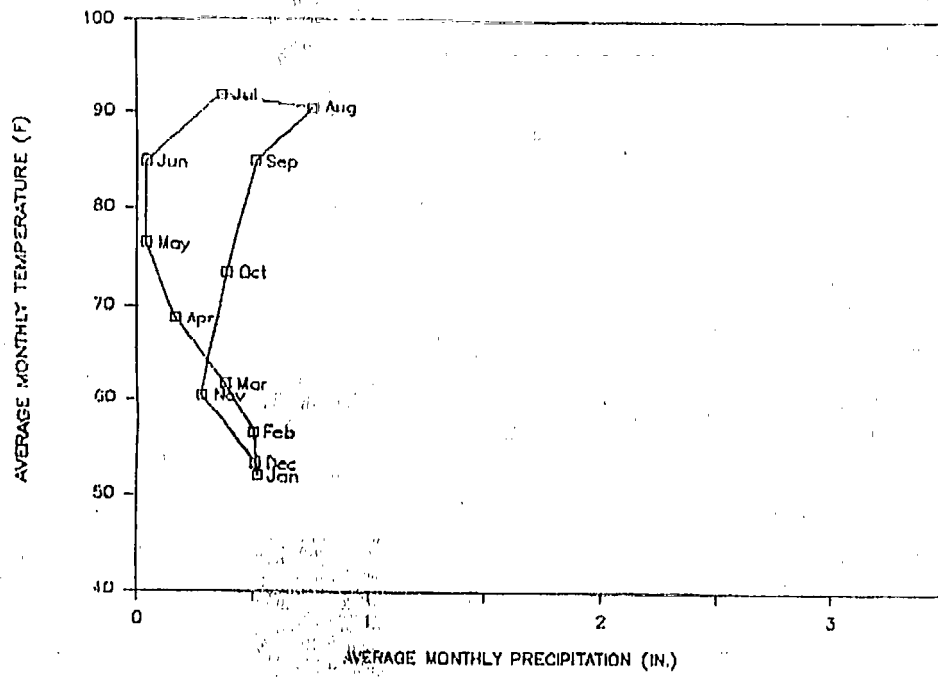


ALPINE, TX

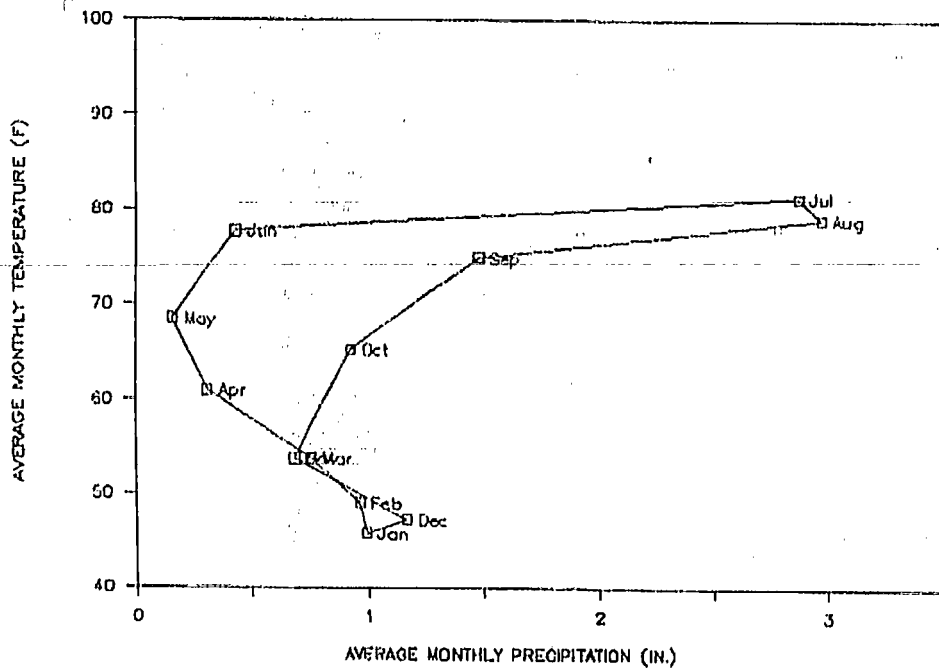


Appendix 4
Climographs for divisional long-term precipitation averages
(1931-1980).

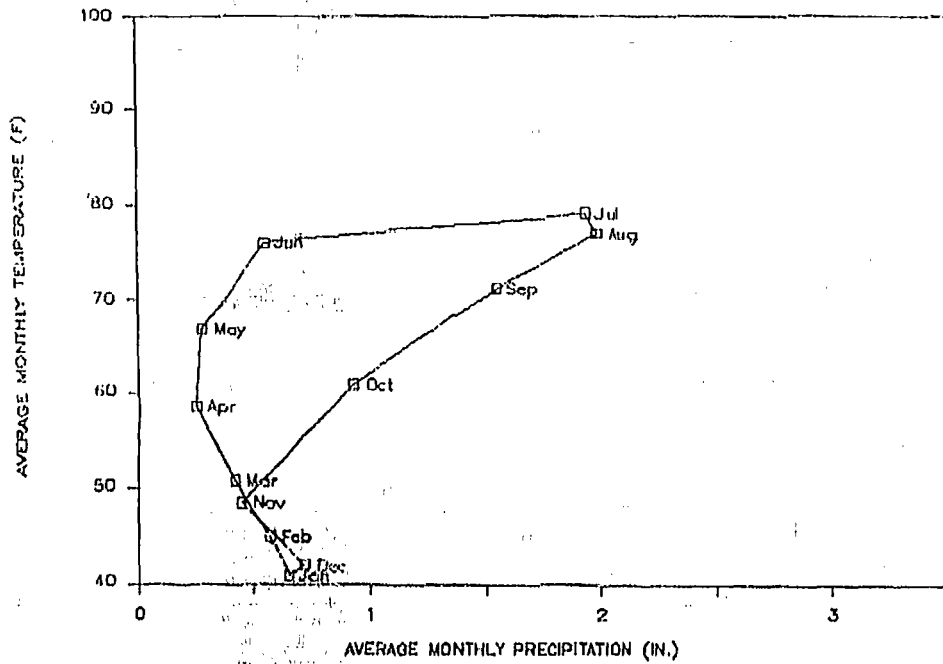
ARIZONA SW



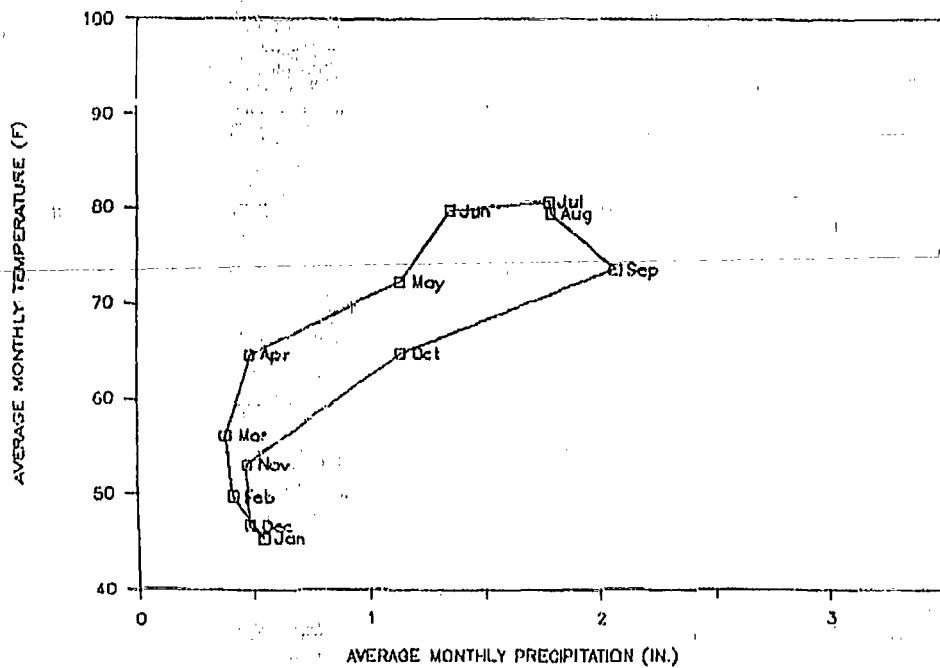
ARIZONA SE



NEW MEXICO — SOUTH DESERT



TEXAS — TRANS-PECOS



Appendix 5.

**Guide to formulating pronghorn antelope transplant
priorities in Arizona.**

GUIDE TO FORMULATING
PRONGHORN ANTELOPE TRANSPLANT
PRIORITIES IN ARIZONA

David E. Brown

Unlike some other states, pronghorn were never extirpated from Arizona. After reaching a low of an estimated 650 animals in the early 1920s (E. W. Nelson 1925, USDA Bull. 1346), pronghorns again increased to huntable numbers in the northern portions of the state. Pronghorns were extirpated however, from the Arizona Strip, southeast Arizona (Cochise, Graham, Santa Cruz, and eastern Pima County), and parts of west central Arizona.

Beginning in 1942-43 a trapping and transplanting program reintroduced pronghorn to House Rock Valley, the Sonita-Elgin Valley, San Rafael Valley, parts of Sulphur Springs Valley, and near Arivaca. Transplants to San Simon Valley, north of Oracle Junction, and Sheriff's Mesa between the Sierrita and Cerro Colorado Mountains were unsuccessful.

In 1961, pronghorn transplants were again initiated, this time to the Arizona Strip. After successive transplants, pronghorn were once again established in Antelope Valley and adjacent areas in Game Management Unit 12A. In 1979 and again in 1982, pronghorns from the Great Basin and eastern Colorado were released in the Main Street Valley area in Game Management Unit 13B in hopes of establishing a population there.

Also in 1981, ca. 50 Antilocapra americana mexicana were transplanted from west Texas to the Cienega Ranch between the Whetstone and Santa Rita Mountains in Game Management Unit 34B. Follow-up transplants are planned.

Other potential pronghorn transplant sites have been proposed for areas in San Bernardino Valley, Sulphur Springs Valley, Altar Valley, areas within the Tonto National Forest, the Hillside-Kirkland area, and isolated areas in northern Arizona. To maximize the chances of success and establish a priority for future transplant efforts, the following criteria were developed for scoring and rating candidate areas. Each criteria has a rating from 1 to 4. A rating of 1 in any category would preclude a transplant.

- A. Historic Occurrence of Pronghorn: The past presence of the subspecies of pronghorn available is an indication that the proposed site was at least formerly suitable for this race. The larger and/or more persistent these populations were, the higher the rating--provided that factors clearly identifiable as responsible for the initial decline are no longer present.

1. No records of occurrence.
 2. No records of sizable numbers (100+).
 3. Sizable numbers present after the year 1900.
 4. Sizable numbers of animals present after the year 1925.
- B. Land Status: This considers the dominant land-ownership pattern. Those areas administrated by a public land management agency having a commitment to wildlife and public hunting were given a higher priority than lands reserved or subject to more utilitarian use.
1. Mostly U.S. National Park Service or Indian Reservation Lands.
 2. Mostly State and/or private lands.
 3. Mostly State of Arizona lands.
 4. Mostly U.S. Forest Service or Bureau of Land Management lands.
- C. Topography: Each site is to be rated for suitability of terrain: Undulating plains, low hills, and extensive areas of gentle relief were considered good fawning sites and escape topography.
1. Little level ground; topography broken with sharp relief.
 2. Some level plains but low rolling hills lacking or nearly so; canyons and incised drainages present.
 3. Level plains with some low hills of gentle relief; few areas dissected by canyons and drainages not incised.
 4. Extensive plains with areas of low hills, "hidden" folds, swales, and valleys; few canyons, and drainages not deeply incised.
- D. Cover: Landscape physiognomy is an important factor that can be subjectively evaluated. Sites having extensive vistas, a generally open vegetative cover, and little or no shrub or tree cover are favored over sites having a densely structured or brushy aspect with vegetation 2 m or more in height.
1. Mostly shrubby, brushy cover (e.g., junipers, chaparral, etc.).

2. Much shrubby, brushy cover with an interspersion of low structured open vegetation.
 3. Some shrubby, brushy cover interspersed with low structured open vegetation.
 4. Mostly uncluttered open terrain with only occasional brushy cover.
- E. Range Conditions: The presence (or absence) of perennial forbs and other favored pronghorn foods should be noted. Conversely, the presence or dominance of noxious weeds and perennial shrubs such as burroweed (Haplopus tenuisectus), and snakeweed (Gutierrezia sarothrae) are important from a negative standpoint. The density and structure of residual grasses and/or shrubs is also important for fawning cover.

1. Poor -- Few perennial forbs; perennial grasses scattered, with poor vigor, and closely cropped. Browse species show hedging. Annuals prevelant and the dominant cover is such noxious shrubs as burroweed and snakeweed.
2. Fair -- Perennial forbs and grasses found at some distance from water. Browse and grass cover are in less than thrifty condition except where far from water. Noxious shrubs interspersed among short statured, scattered grass cover.
3. Good -- Perennial forbs scattered throughout. Grass cover in a thrifty condition with perennial grasses having seed heads visible. Key browse species show good growth and little hedging. Shrub cover compact and not composed of noxious species.
4. Excellent -- A great variety of perennial forbs available; residual grass cover present from previous year. Perennial forbs, grasses, and/or compact shrubs and browse are thrifty and widespread. Little bare ground with noxious shrubs scattered and in low density.

- F. Presence of Other Ungulates: Competition for forage exists between pronghorn and domestic sheep, and between pronghorn and cattle if the range is heavily stocked. Livestock may also graze out or shorten the grass and/or shrub cover used to conceal pronghorn fawns. Deer, and equines, if in large numbers, may also compete for forage with pronghorns, and may indicate a general unsuitability of the habitat for pronghorn. The presence of ungulates that may act as hosts for pronghorn diseases is another consideration. Of special concern in this regard are

domestic sheep, goats, uninspected steers, and excessive numbers of deer.

1. Heavy use by livestock (cattle and horses), and/or the pasturing of sheep and goats in most of the release area. A year-long cow-calf operation is the ranch management plan on most of the proposed release site.
2. Heavy use by cattle and horses; no sheep or goats in vicinity of release site. Cattle use mostly seasonal; large numbers of deer may be present.
3. Moderate use by cattle; no sheep or goats in vicinity of release site. Cattle operations are confined to seasonal use by steers; low or moderate number of deer present.
4. Light or no grazing by cattle; cattle use seasonal only. No sheep or goats in vicinity of release area; deer numbers low or moderate.

G. Fences: Fences, if numerous, and if woven or of several stands, can severely handicap pronghorn movement. These restrictions can result in pastures being unavailable for pronghorn and reducing the quantity and quality of pronghorn habitat.

1. Pastures small; numerous, well maintained 5 strand fences and/or sheep fences in candidate area.
2. Pastures small but few well maintained 5 strand fences; no or few woven sheep fences.
3. Pastures of moderate size; at least some fences loose enough to allow easy passage of pronghorns. No or few woven sheep fences.
4. Pastures large with most fences loose enough to allow easy passage of pronghorns from one pasture to the other.

H. Seasonal Availability of Habitat: Although normally not a problem in Arizona, severe winters can isolate and decimate antelope populations. Such a situation occurred in eastern Arizona in 1966-67 and will happen again in certain areas of the state.

1. Candidate area subject to severe winters with daily temperature maxima below freezing and/or heavy snowfall during most winters. No readily available winter range because of human occupation, lack of lowland areas, or other reasons.

2. Candidate area periodically subject to severe winters with daily temperature maxima below freezing and/or heavy snowfall. Limited available winter range because of human occupation, lack of lowland areas, or other reasons.
 3. Candidate area rarely subject to severe winters with daily temperature maxima below freezing and/or heavy snowfall. Winter range available in adjacent areas.
 4. Area never subject to severe winters.
- I. Available Water: Large populations of pronghorn require free water. Although water need not be generally available throughout the proposed habitat, some water should be available at all times. Ideally these waters should be sufficient, dependable, and relatively uncontaminated. Natural waters are almost always developed and therefore more or less contaminated by livestock.
1. No free water located.
 2. Permanent free water uncertain; available waters used by livestock.
 3. Permanent available water, all sources used by livestock.
 4. Permanent available free water, some relatively uncontaminated by livestock.
- J. Habitat Discreteness: Sites having a good dispersion of potential pronghorn habitats are to be selected for. Candidate habitats isolated by dense cover, steep terrain, or otherwise unavailable areas are less desirable than those having an interspersed of more suitable types.
1. Pronghorn habitats of suitable cover and topography separated by poor quality areas.
 2. Monotypic habitat -- little variety--homogeneous area of suitable cover and topography.
 3. Good habitats -- an interspersed of adjacent areas of suitable cover and topography.
 4. Extensive areas of a variety of good habitats.
- K. Human Disturbance: Man's developments and recreational use importantly effect pronghorn distribution. Those areas subject to large amounts of human activity have less potential for a successful transplant than areas

receiving a minimum of disturbance. Mining, prospecting, and recreation activity, and most importantly, residential developments were considered as detracting from a potential release site.

1. Candidate area has residential developments or receives heavy recreational, mining, or travel use.
 2. Candidate area subject to residential development or receives substantial recreational, mining, or travel use.
 3. Candidate area subject to moderate recreational, mining, or travel use.
 4. Candidate area subject to little human disturbance.
- L. Range Expansion Potential: The contiguous size of potential pronghorn range is a consideration for measuring the potential for population expansion. Areas having an inferred potential for supporting large numbers of pronghorns are considered superior to smaller areas of similar or even superior habitat.
1. Little opportunity for range expansion; population levels likely to remain at less than 50 animals.
 2. Some opportunity for range expansion; a released population might expand (or remain) at 50 to 100 animals.
 3. Good potential for range expansion; a population of 100 to 200 animals could be realized if the release is successful.
 4. Excellent potential for range expansion; a population of more than 200 animals can be expected if the release site is successful.

It must be remembered that no area, no matter how high its aggregate score will not result in a successful transplant if landowners or leases are opposed to the establishment of pronghorns on their range. Landowner and/or leasee cooperation is therefore a primary prerequisite for any release program providing the area is judged suitable by the above criteria.

An example of how the rating system would work is shown in the following table.

Candidate Area	A 1234	B 1234	C 1234	D 1234	E 1234	F 1234	G 1234	H 1234	I 1234	J 1234	K 1234	L 1234
Cooke's Mesa, Tonto N.F.	X	X	X	X	X	X	X	X	X	X	X	X

As noted, the score for this candidate site is a relatively low 30 of a possible 48 (62 1/2%); of even more importance, the "I" rating given for criteria J and L would preclude a recommendation for a pronghorn release in this area.